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ABSTRACT

A project was conducted to develop vocational education tests for use in Georgia secondary schools, specifically for welding, machine shop, and sheet metal courses. The project team developed an outline of an assessment model that included the following components: (1) select a program for use in developing test items; (2) verify duties, tasks, and performance objectives; (3) review existing test items; (4) develop criterion-referenced test items; (5) edit test items; (6) field test items; and (7) design a storage and retrieval system for criterion-referenced test items. The project team followed these seven steps to create evaluation instruments. Results of the project were three tests: a 68-item multiple-choice test for welding courses, and 100-item multiple choice tests for machine shop and sheet metal courses. (These tests make up the majority of this document. Workpapers used in developing the tests are included in appendixes to this report.) (KC)

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ED256887

FINAL REPORT

of the

GEORGIA VOCATIONAL STUDENT ASSESSMENT PROJECT

Provided to the

OFFICE OF VOCATIONAL EDUCATION
GEORGIA STATE DEPARTMENT OF EDUCATION

By the

VOCATIONAL-TECHNICAL EDUCATION CONSORTIUM OF STATES
SOUTHERN ASSOCIATION OF COLLEGES AND SCHOOLS

795 Peachtree Street, N.E.
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September 1, 1984

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INTRODUCTION

This report concerns a problem that continues to perplex teachers and their colleagues in the related disciplines of administration, supervision, and evaluation. Namely, vocational student assessment. The complexity of the problem is awesome. It requires a concerted commitment of educators to provide resources over an extended time frame to resolve the issues of assessment. The Georgia Office of Vocational Education made that commitment in September of 1982 and thus set the stage for a logical and realistic attack on the problem through support of a vocational student assessment project, funded with the Southern Association of Colleges and Schools.

At the outset it is important to note the decisions made by Georgia officials in the State Office of Vocational Education prior to funding the project. Those initial judgments provided a solid foundation for the work that followed during the next two years. They were:

1. Student assessment shall be made over publically stated performance objectives.

2. Peformance objectives shall be identified from an analysis of occupational tasks validated by incumbents.

3. Analysis of tasks shall include specifications of: (a) psychomotor and cognitive bases, (b) safety hazards, (c) tools and equipment required to perform the "doing" steps, (d) standards of achievement validated by incumbents, and (e) special conditions for task completion, such as time/space factors.

4. Assessment devices shall include written and performance items.

5. Items shall be prepared by test experts using specifications identified in an analysis of tasks.

6. Items shall be criterion-referenced based for purposes of administration, preparation of reports, and interpretation.

7. Items shall be validated by establishing congruence of the standard in the task with the item. Subject matter experts (SME's) shall serve as the judges.

8. Items shall be coded for purposes of storage, retrieval, processing, and reporting results.

9. All test items shall be available to teachers for use throughout the teaching-learning process.
10. A clearing house shall be established to coordinate the assessment activities within the state of Georgia.
11. In establishing a test item pool, existing items shall be identified and critiqued for consideration and possible inclusion in the pool; thus, eliminating unwarrented duplication of efforts.

Commitment to this kind of process led the Georgia decision makers to fund a project with the Southern Association of Colleges and Schools. The assignment was to develop and test a model for assessing Georgia vocational students over competencies identified in selected occupational areas.

During the first ten months of the project, a review of literature in the areas of; (a) competency-based vocational education, (b) Federal Vocational Legislation, and (c) assessment problems and advancements was conducted. The purpose of the study was to provide assurance that developers be aware of the latest experiences and methods available in designing and developing a model for criterion referenced test items.

Results of the study verified prior notions that the emphasis on vocational student assessment has increased, in part, as a result of public and institutional concerns regarding the paucity of valid means to document student learning. Such concerns resulted in the present interest in competency-based vocational education and criterion-referenced assessments.

Based upon the review, the outline of an assessment model was developed. Included were the following components:

1. Select a program for use in developing test items.
2. Verify duties, tasks, and performance objectives.
3. Review existing test items.
4. Develop criterion-referenced test items.
5. Edit test items.
6. Field test items.
7. Design a storage and retrieval system for criterion and referenced test items.

Following acceptance of the Literature Review and the Draft Model, the Georgia Office of Vocational Education funded the second year of the project to test the components of the model. The test consisted of implementing each component to identify its usefulness, relationships to overall model effectiveness, and required revisions.

The remainder of the report presents activities employed in field testing each component of the model, successes and problems encountered, and recommendations for revision.

COMPONENT I

SELECT A PROGRAM FOR USE IN DEVELOPING TEST ITEMS

This component was included in the model to assure that high priority programs would be addressed and that unwarrented duplication would be eliminated.

The model required that criteria be established for use in program selection. The criteria were:

Criterion 1. An occupational program or course should be selected from the task linkage projects. This criterion is necessary because of the articulation relationships established between secondary and postsecondary programs. Also, the tasks must be organized and listed in a logical sequence believed to be important by Georgia educators.

In keeping with the requirement to place items in a computerized item bank, the coding of tasks by D.O.T., C.I.P., and O.E. numbers will be added useful information from the task linkage projects.

Criterion 2. An occupational area should be selected in which state or national licensure is not a requirement; since licensure is based upon accepted local standards by the profession or trade.

Criterion 3. An occupation should be selected for a technical area with emphasis placed on expanding or advancing technology.

Criterion 4. An occupational area should be selected for which a criterion-referenced test item bank is not available. Since many individual test items are available for adoption or adaption, it is important to make certain that thorough searches to identify available sources for possible use are conducted.

Identification of an occupational program was accomplished in

August, 1983 by the decision makers in the Office of Vocational Education. The area selected was the Metals Fabrication Cluster for secondary programs. It is a cluster offering machine shop, sheet metal, and welding to students in approximately one hundred Georgia schools.

COMPONENT II

VERIFY DUTIES, TASKS, AND PERFORMANCE OBJECTIVES

Following identification of the cluster the activities listed below were initiated and completed by project staff.

- A request for task listings was made to the Office of Vocational Education.
- A review of each task list provided was made to identify the scope of program content. During the review it was evident that all three occupational areas were inconsistent in terms of heirarchies of tasks. That is, high level tasks were included when subordinate tasks did not appear on the list. It was also noted that some statement formats did not provide a complete

description of a task. Based upon the discrepancies, the staff spent many hours in revising the lists and rewriting the task statements to be in keeping with the V-TECS definition of a task. In essence, three sets of secondary tasks were developed (See Appendix A for task listings).

- A review of curriculum materials, V-TECS catalogs, and other Georgia instructional materials for the cluster was made to identify task analyses. In general, it was found that tasks and performance objectives in the V-TECS catalogs were written for postsecondary level students, not secondary school students as defined by the Metals Fabricatin Cluster.
- The review failed to identify task analyses for the Metals Fabrication Cluster which could be used. Therefore, the staff developed a procedure to collect task analysis information. Project staff developed work sheets and collected information using reference materials, incumbents, and subject matter experts not associated with the verification process. The following kinds of data were collected for each task:

occupation, duty, performance objective, steps in performing the task, knowledge and skills required, tools and equipment required, and safety factors associated in performing the task. (See Appendix B for a copy of the survey form).

- A validation of the task analysis was initiated through the following steps:
    - Subject matter experts were identified by the Georgia Office of Vocational Education staff. All subject matter experts were current employees of County School Systems. They were teachers of the Metals Fabrication Cluster program (See Appendix C for list of Georgia subject matter experts).
    - Incumbents were not used in the validation study; however, it is strongly recommended that they be included in future test item development.
    - The standards, or criteria used to verify the task analysis information, were prepared and agreed upon by Georgia officials in the Office of Vocational Education

(See Appendix C for task analysis validation guidelines).

- •• The subject matter experts were invited to attend an orientation meeting in Atlanta, Georgia. At this time the nature of the Georgia Student Assessment Project was explained and their role in meeting the goals was made clear to each participant. Each participant received a copy of the task analysis validation guidelines and a set of all completed task analysis work sheets. Dates were set for return of the reviews by the subject matter experts.

- •• Reviews were received by the staff and analyzed. Criteria for deletions, or additions required a consensus of opinion. If agreement could not be reached among the subject matter experts, then a selected number of incumbents were used to resolve the questions.

- It is interesting to note that subject matter experts recognized, as they completed reviews of task analysis work sheets, the relationship of task analysis to curriculum and test item development. Several subject matter experts requested, and were granted permission, to use the work sheets in the development of their curriculum.

- The analysis also revealed that data on task difficulty and frequency could not be used to make decisions regarding items to be written due to the fact that subject matter experts regarded all items of equal importance and difficulty. The finding is in keeping with U. S. Air Force conclusions about the usefulness of data on frequency and difficulty.

COMPONENT III

REVIEW EXISTING TEST ITEMS FOR ADOPTION OR ADAPTION

- All available test items were collected through a search including Georgia teachers, Florida Educators Information System, other V-TECS states, commercial publishers, and the Ohio State Center for Vocational Research and Development.
- Test items were matched to tasks, when possible.
- Each item was reviewed for content validity and acceptability. The review showed a wide range of testing procedures currently

being used by teachers in the Metals Fabrication Cluster. Some teachers were obviously using a criterion referenced methodology and submitted items that with very little adaption could be incorporated into the item bank; however, the majority of items received were of a nature of items often found at the conclusion of a textbook (See criteria in Appendix E).

COMPONENT IV

DEVELOP CRITERION-REFERENCED TEST ITEMS

- A review of the task analysis work sheets was made to identify skills or knowledge required in more than one task in order to eliminate duplication of item development. This is an activity requiring intense work by staff in large blocks of time when carried out manually. During FY 1985 the process will be accomplished through use of a computer.
- A review of each performance objective to determine if written, performance, or both written and performance items should be developed was made (See Appendix F for additional explanation).

- Item specifications were written to show if performance, written, or both types of items were required (See Appendix F).
- If written items were required specifications were made about; recall of knowledge and information, application of knowledge and information, or both recall and applicaton of knowledge.
- If performance test items were required, the specifications in the performance objective related to conditions, specifications, tools and materials, and procedures were followed.
- Items were written according to specifications.
- Items were reviewed by staff writers, revised, and then prepared for review by subject matter experts, and incumbents as shown under the heading V below. It is highly recommended that subject matter experts other than those used in the validation of the task analysis be used to review the items.

COMPONENT V

EDIT TEST ITEMS

- An item review check list was developed (See Appendix G). The purpose of the check list was to standardize the means of determining item consistency and adequacy.

- Subject matter experts were assembled and given a copy of all test items and review check sheets.
- Directions, relative to the use of the review check list, were given to the subject matter experts.
- Subject matter experts reviewed the items and returned the reviews to the project staff with recommendations.
- Staff members for the project analyzed the results of the SME's review using the following guidelines; items to be retained and placed in the bank were those which contained no suggestions for revisions by the subject matter experts. In addition, an item was retained only when subject matter experts agreed upon a correct answer (See Appendix H). Use of the very rigorous criteria resulted in the elimination of approximately one-half of the original items written. In some cases the subject matter experts agreed upon the technical soundness of the item, but indicated that it represented a higher than secondary skill or performance level. Such items were not included in the bank.

Upon reflection, this indicates a necessity to reexamine the process of task analysis validation. Specifically, a question about whether or not the subject matter experts taught the task must be added to the review process. A case in point relates to the items which were developed, and later in part discarded, for the duty areas of operating milling machines and operating shapers. The rationale for eliminating these items that were technically sound, but were not taught by the subject matter experts was based upon the requirement to field test the items at a later date in the classes of the subject matter experts.

If the number of subject matter experts and field test sites is increased, the necessity to eliminate items on this basis will be lessened. It is recommended that the field test be conducted in schools other than those of the subject matter experts participating in the validation processes; and if feasible, at different levels; i.e., secondary and postsecondary.

- Project staff members rewrote items where required. The items were then assembled and coded as to occupation, duty, task, and domain.

- The items will be further coded according to O.E., C.I.P., and D.O.T. numbers before entry into the bank. It is strongly recommended that the coding include the origin and date of development (For more information see Appendix K).

COMPONENT VI

FIELD TEST ITEMS

- A random selection of 238 written items was made for use in the field test (See Appendix I). It should be noted that subject matter experts did not have time to test performance items before the end of school in June. The items will be tested during early school year 1984-85. Thirty-eight for sheet metal, and one hundred each for welding and machine shop were the total number of items tested. The number was determined by asking subject matter experts the maximum length of a test that could be realistically administered to students who had completd the program of training. Each subject matter expert used the same items; however, they tested only those items related to areas of instruction completed by the students.

- Results of the field test follow.
  - •• 180 students took the field test in seven Georgia schools,

    23 students in sheet metal,

    60 students in welding, and

    97 students in machine shop.
  - •• Results were returned to staff.
  - •• Staff members conducted a standard item analysis on the results. Such data was reviewed as to the number of students answering each item correctly and the number of students selecting each distractor.
  - •• Staff members manually scored the items against a key for each student. The results were recorded by school to show the total wrong answers over the total number of students responding to the item (See Appendix J).

    This allowed the staff to determine whether any items were consistently answered incorrectly in all field test sites by those who had a high total test score (80 percent or better). If so, a further probe was directed toward the distractors selected. Staff members assumed that when high scoring students consistently selected a particular distractor an investigation should be made to determine whether or not the item, the distractor, or both were misleading.

Only four items were investigated; however, the practice proves the necessity to examine item responses across schools as a way of identifying poor criterion-referenced items.

Because the field test represented only one possible collection of items from those developed, descriptive statistics such as mean, standard deviation, and variance were not used. They were, however, computed along with the Rel-KR20 which was .872; for the items selected for use in the field test.

•o The staff revised the several items prior to sending them to the SME's for review and finally, upon revision, to SACS for typesetting.

Each student taking the test and teachers administering the test were asked to respond to:

- Completeness of items
- Usefulness of item format
- Directions for completing test items
- Clarity of overall test administration.

Some responses were provided by the administrators of the test items. In general, they were editorial and not changes in substance. The wording, formats, directions, and overall acceptance of the items were unanimously favorable.

The time required to administer the items did not vary significantly among the schools. In all instances one class period was used.

COMPONENT VII

DESIGN A STORAGE AND RETRIEVAL SYSTEM

A broad search was made to identify and study systems already in use. Several were identified, however, those with greatest promise were closed to replication, or were too costly to purchase. Finally, one in which all elements required for the Georgia system was located in the University of South Florida.

The State Director of Vocational Education in Florida, Mr. Joe D. Mills, was contacted relative to use of the computer system for storing, processing, and generating reports, and retrieving test items. Consent was given to use the system, which cost approximately 1.25 million dollars to develop, test, and revise. The system was secured through Dr. Margaret Ferqueron and Dr. Roy Giehls of the Florida Department of Education, Division of Vocational Education. It contains seventy-six programs on magnetic tape, discs, and print. All have been acquired and are in a safe at SACS. Before acquisition, the programs were run on a large IBM computer at the Florida State University to determine if the data collected in the field test could be analyzed.

The test was positive with the contrived data. Printouts show the capability to:

- Store items coded by occupation, duty, task, origin of development, CIP number, DOT, grade level, item type, i.e., written, performance, and if written, whether the item is multiple choice, T.F., completion, or matching.
- Retrieve and print items requested by one or more of the codes.
- Score answer sheets on the items selected.
- Provide an analysis of item scores.
- Generate reports on item scores by student, occupation, school, and state.

The system will be placed on the V-TECS Data General System and will be made available to all Georgia teachers in FY 1985. During the interim, manual searches will be used to meet requests of persons desiring Metal Fabrication Cluster criterion-referenced items. Scoring, presentation of results, and maintenance of the system will be a responsibility of SACS, V-TECS during FY 1985. Details for maintaining the system will be developed and completed during the next phase of the study.

COMPONENT VIII

SUMMARY STATEMENTS

The model as reported is productive of useful criterion referenced test items to be included in the test item bank for Georgia teachers of vocational education.

Large blocks of time were used by the project staff members to design collection instruments, write tasks, validate tasks, conduct analyses, develop items, and validate and revise items. The time required was greater than had been expected. It is gratifying to note that the item development model was completed on time and that more than twelve hundred items were produced. Approximately half of the items were discarded because they did not fit the secondary cluster. Had it been known that the project was to be continued most of the items could have been used at the postsecondary level for welding and machine shop. The experience leads to the decision, "never discard a technically sound item."

During the process of testing the components in the system, staff members formulated a number of generalizations that should be used in future developmental work of test items.

1. Include incumbents, teachers, and experts in the process of validating analysis of tasks, and the validity of items.
2. Field test over at least 200 students in a diversity of school sites geographically located throughout the state. The sites should not be the same schools in which subject matter experts are employed.
3. Plan well in advance the use of field test sites so that teachers can be taught how to administer the test items.
4. Develop a computer program to analyze common elements among tasks through [illegible] of identifiers.
5. Hold meetings with subject matter experts as soon as possible after deciding upon occupations, or courses for test item development. Early involvement assures the transfer of ownership and increases the possibility of item use.
6. After completion of test items conduct planned seminars for potential users to assure proper levels of awareness, interest, trial, and hopefully, acceptance of the items

rather than rejection of the items.

In conclusion, the system as developed works. It should be used, with revisions noted, to develop additional test items. At the same time the system must be maintained, a computer component instituted, and assessments made to establish data relating to its impact on the improvement of vocational education.

COMPONENT IX

APPENDIX A

TASK LISTINGS

ENCLOSURE A

WELDING

DUTY A - FLAME CUTTING

1. Set up oxyacetylene cutting/welding equipment
2. Cut straight line
3. Pierce and cut holes
4. Make circular cuts

DUTY B - OXYACETYLENE WELDING

1. Make weld beads using a rod
2. Make an outside corner joint without a rod
3. Make an outside corner joint with a rod
4. Make a flat fillet T-joint
5. Make a lap joint
6. Make a square edge butt weld

DUTY C - BRAZING

1. Make braze welding beads
2. Make an outside corner joint braze weld
3. Make a T-Joint braze weld
4. Make a lap joint braze weld
5. Make butt braze weld
6. Make beveled butt braze weld

DUTY D - ARC WELDING

1. Set up arc welding equipment
2. Practice running beads
3. Make a square edge butt joint
4. Make a flat T-Fillet joint
5. Make a lap joint
6. Make an outside corner joint
7. Make a 30° V Butt joint
8. Make a single Bevel T-Joint
9. Make a double Bevel T-Joint

DUTY E - HORIZONTAL ARC WELDING

1. Practice running beads
2. Make a lap joint
3. Make a square edge butt joint
4. Make a T-Joint

DUTY F - VERICAL ARC WELDING

1. Practice running beads
2. Make a lap joint
3. Make a square edge butt joint
4. Make a T-Joint

DUTY G - OVERHEAD ARC WELDING

1. Practice running beads
2. Make a lap joint
3. Make a square edge butt joint
4. Make a T-Joint

DUTY H - TIG WELDING

1. Set up tig welding equipment
2. Practice running beads
3. Make a butt joint

DUTY I - MIG WELDING

1. Set up mig welding equipment
2. Make fillet welds
3. Make butt welds

ENCLOSURE B

SHEET METAL

DUTY A - LAYING OUT SHEET METAL

1. Square sheet metal
2. Lay out sheet metal patterns on paper
3. Trace templates on sheet metal

DUTY B - PRODUCING SHEET METAL

1. Cut sheet metal with hand tools to produce a straight cut
2. Cut sheet metal with hand tools to produce an irregular cut
3. Cut sheet metal with hand tools to produce a circular cut
4. Cut sheet metal with hand tools to produce a notched cut
5. Cut sheet metal with hand tools to produce an internal cut
6. Cut sheet metal with machinery to produce a circular cut
7. Cut sheet metal with machinery to produce a notched cut

DUTY C - PRODUCING SHEET METAL ASSEMBLIES

1. Spot weld sheet metal
2. Solder sheet metal
3. Fasten sheet metal parts with sheet metal screws
4. Bolt sheet metal parts
5. Rivet sheet metal parts
6. Drill receiver holes in sheet metal

DUTY D - FORMING SHEET METAL

1. Crimp sheet metal
2. Bead sheet metal
3. Form a single hem
4. Form cylinderical shapes on a slip roll forming machine
5. Form a double hem
6. Form a dovetail seam
7. Form a double seam
8. Form a single seam
9. Form a Pittsburgh lock seam
10. Form a grooved seam
11. Form a drive-clip seam

BEST COPY AVAILABLE

MACHINIST

DUTY A - DESIGNING AND PLANNING MACHINE WORK

1. Make sketches of work to be machined

DUTY B - PERFORMING PRECISION MEASUREMENTS

1. Measure work with a 6" pocket rule
2. Layout work with a combination square
3. Measure inside and outside diameter with vernier caliper
4. Measure work with depth gages
5. Measure work with depth micrometer
6. Measure work with inside micrometer
7. Measure work with outside micrometer
8. Measure work with telescope and hole gages
9. Measure work with depth blocks
10. Check work with surface gage
11. Layout work on a surface place

DUTY C - PERFORMING BENCHWORK

1. Hand whet cutting tools
2. Mark locations with prick and center punches
3. Locate holes with transfer screws and punches
4. Benchfile workpiece
5. Cut material with hand hacksaw
6. Cut threads with hand tap
7. Cut threads with die
8. Drill holes with portable drill
9. Grind part with hand grinder
10. Hone workpiece
11. Polish metal
12. Ream holes with hand reamers
13. Straighten workpiece with arbor press
14. Work and shape metal with hand tools

DUTY D - OPERATING DRILL PRESSES

1. Drill hole to size
2. Countersink hole to specifications
3. Ream hole to size
4. Counterbore hole to specifications

DUTY E - OPERATING GRINDERS

1. Dress and true grinding wheels on pedestal grinder
2. Polish with a grinding machine
3. Grind and shape chisels and hand tools on pedestal grinder

DUTY F - OPERATING LATHES

1. Align lathe centers
2. Align workpiece in four-jaw chuck
3. Align workpiece on face plate
4. Set lathe speed and rough cut workpiece
5. Set lathe speed and finish cut workpiece
6. Face workpiece
7. Turn workpiece between centers
8. Bore holes
9. Counterbore holes
10. Drill holes
11. Countersink holes
12. Ream holes
13. Knurl parts
14. Chase external threads
15. Cut an external tapered surface with taper attachment

DUTY G - OPERATING MILLING MACHINES

1. Align workpiece mounted on machine table
2. Align mill head to table
3. Cut off work on mill
4. Flycut flat surface on mill
5. Mill an angular surface
6. Machine woodruff keyway
7. Machine external straight keyway

DUTY H - OPERATING SHAPERS

1. Machine flat surface
2. Cut angular surface
3. Cut verticle surface
4. Machine keyway

APPENDIX B

TASK ANALYSIS WORKSHEET

APPENDIX B

Task Analysis Worksheet

DUTY:

TASK:

PERFORMANCE OBJECTIVE:

Steps	Tools and Equipment Use	Key Points Knowledge & Information	Safety Hazards

Frequency of Performance

1. Daily	
2. Weekly	
3. Monthly	
4. Periodically	

Level of Difficulty

1. Easy	
2. Moderate	
3. Difficult	
4. Very Difficult	

APPENDIX C

GEORGIA SUBJECT MATTER EXPERTS

APPENDIX C

List of Subject Matter Experts for 238 Randomly Selected Items

1. Wayne Sapp
Valdosta High School
Valdosta, GA 31602

2. John Layfield
Cedartown Comprehensive High School
Route 1
Cedartown, GA 30125

3. Ed Wilks
Occupational Education Center South
DeKalb County Schools
Decatur, GA 30334

4. Quentin Haynes
Calhoun High School
Calhoun, GA 30701

5. Carl Matricardi
Gwinnett Vocational Technical Center
Lilburn, GA 30245

6. Mark McElreath
Jordan Vocational High School
Columbus, GA 31904

7. Jim Ellis
Lithia Springs Comprehensive High School
Lithia Springs, GA 30057

APPENDIX D

TASK ANALYSIS VALIDATION GUIDELINES

APPENDIX D

TASK ANALYSIS VALIDATION GUIDELINES

1. Is the task correctly stated? YES____ NO____. If "NO," how should it be stated?____

____

2. Does the performance objective specify:
   a. the conditions under which the performance is to take place? YES____ NO____.
   b. the behavior desired or expected of the student? YES____ NO____
   c. the level of performance necessary to achieve the objective? YES____ NO____.
3. Are all steps necessary to perform the task listed? YES____ NO____ If "NO," please list those missing.____

____

4. Is the sequence of listed steps correct? YES____ NO____ If "NO," please sequence____

____

5. Is all knowledge necessary to perform the steps listed? YES____ NO____ If "NO," please list____

____

6. Are all skills necessary to perform the steps listed? YES____ NO____ If "NO," please list____

____

7. Are all required tools and equipment listed? YES_____ NO_____

If "NO,", please list additions______________________________________

____

8. Are all safety hazards identified? YES_____ NO_____. If "NO," please list additional hazards identified____________________________________

____

Please check the estimated frequency and difficulty of performing the task.

Please initial the worksheet.____

APPENDIX E

CRITERIA FOR REVIEWING TEST ITEMS

APPENDIX E

CRITERIA FOR EVALUATING TEST ITEMS

IB. MEASUREMENT PROPERTIES: CONCEPTUAL VALIDITY

* 1. Description: How good (i.e., thorough and understandable) are the descriptions of the objectives to be tested?

* 2. Agreement: How well do the test items match course objectives?

3. Representativeness: How adequately do the items sample objectives?

IB. MEASUREMENT PROPERTIES: FIELD TEST VALIDITY

4. Sensitivity: Does the publisher claim that conventional instruction leads to test score gains?

5. Item Uniformity: How similar are the scores provided by the publisher, on the different items for an objective?

6. Divergent validity: Are the scores for each objective relatively uninfluenced by other skills?

* 7. Lack of Bias: Are test scores unfairly affected by social group factors?

8. Consistency of Scores: Are scores on individual objectives consistent over time or over parallel test forms?

II. APPROPRIATENESS FOR EXAMINEES

9. Clarity of Instructions: How clear and complete are the instructions to students?

10. Item Review: Does the publisher report that items were reviewed or field tested for quality?

11. Visible Characteristics: Is the layout and print easily readable?

12. Ease of Responding: Is recording answers a problem for pupils?

III. PRACTICALITY

13. Informativeness: Does the test buyer have adequate information about the test before buying it?

14. Curriculum Cross-Referencing: Are the test objectives indexed to at least two series of relevant teaching materials?

15. Flexibility: Are many of the objectives tested at more than one level, and are single objectives easy to test separately?

16. Alternate Forms: Are parallel forms available for each test?

* 17. Test Administration: Are the directions to the tester clear, complete, and easy to use?

18. Scoring: Are both machine scoring and easy hand scoring available?

19. Record Keeping: Does the publisher provide record forms keyed to test objectives that are easy to use?

20. Decision Rules: Are well justified, easy to use rules given for making instructional decisions on the basis of test results?

21. Comparative Data: Are scores of a representative reference group of students given for comparing with your students' scores?

* Critical factors considered by staff reviewers.

Source: Center for the Study of Evaluation, UCLA Graduate School of Education, Los Angeles, California

APPENDIX F

TEST DEVELOPMENT

APPENDIX F

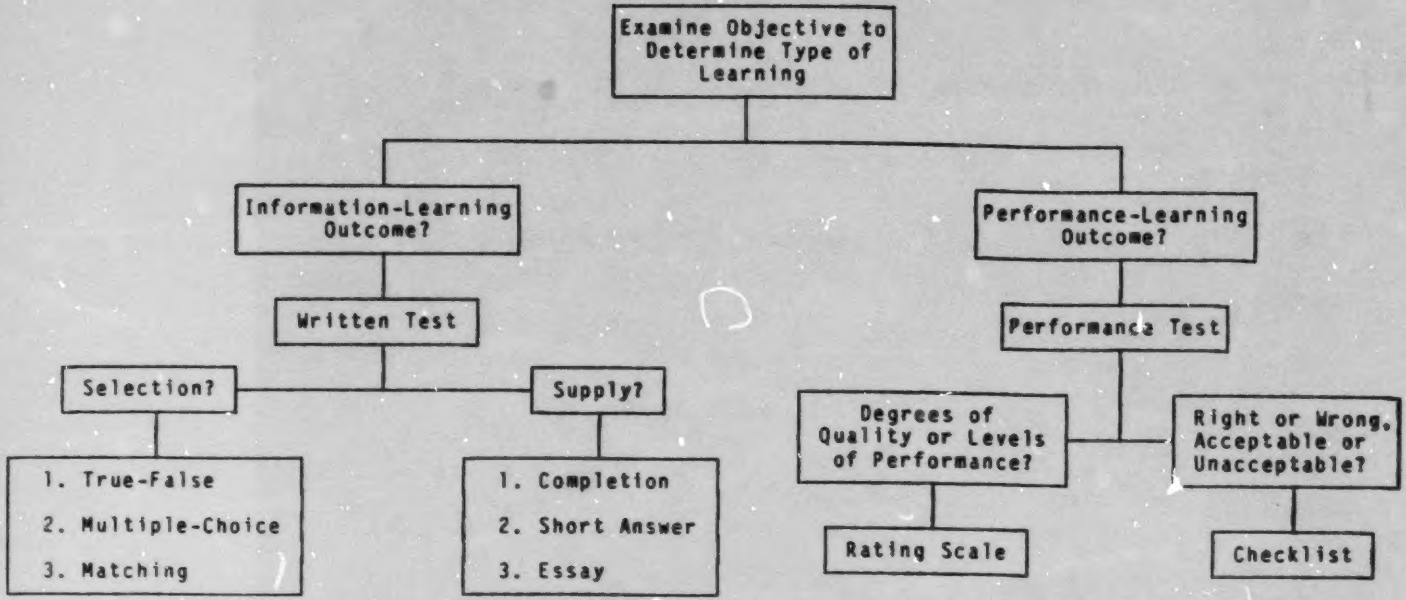
TEST DEVELOPMENT

When it is time to develop a test, examine each objective carefully to determine:

1. Does the task objective require a student to determine knowledge or information about something?
2. Does the task objective require the student to demonstrate the actual performance of a skill?
3. Does the objective require the student to produce a product?

If Number 1 is answered in the affirmative then a written test is required. If either question Number 2 or 3 is answered in the affirmative, then a performance test is required. The diagram on the following page may be of assistance.

Source: "Criterion Referenced Testing," Florida State Department of Education, 1981, p. 50


Examine Objective to Determine Type of Learning
Information-Learning Outcome?
Performance-Learning Outcome?
Written Test
Performance Test
Selection?
Supply?
1. True-False
2. Multiple-Choice
3. Matching
1. Completion
2. Short Answer
3. Essay
Degrees of Quality or Levels of Performance?
Right or Wrong, Acceptable or Unacceptable?
Rating Scale
Checklist

APPENDIX G

AN ITEM REVIEW CHECKLIST

APPENDIX G

ITEM REVIEW CHECKLIST

DIRECTIONS: Review each item and indicate whether it meets the critria listed below. Whenever an item does not meet criteria, explain the specific difficulty and steps that should be taken for correction.

A. Written Items

1. Does the item present a single idea or problem?

YES_____ NO_____. If "NO," explain_________________________________

____

2. Is enough information presented in the item to stimulate the correct response? YES_____ NO_____. If "NO," please explain_________________

____

3. Is occupationally specific terminology used? YES_____ NO_____. If "NO," please explain____

____

4. Is the item tied to a specific performance? YES_____ NO_____. If "NO," explain____

____

5. Is one and only one correct response given? YES_____ NO_____. If "NO," explain____

____

6. Are distractors (incorrect responses) clearly incorrect?
YES____NO____. If "NO, explain____
____

7. Are distractors plausible? YES____NO____. If "NO," explain________
____

8. Are illustrations clear and readable? YES____NO____. If "NO,"
explain____
____

9. Is the item coded to the correct task or tasks? YES____NO____. If
"NO," explain____
____

B. Performance Items

1. Are instructions on the performance expected of the student clear,
concise and complete? YES____NO____. If "NO," explain____________
____

2. Is the performance representative of a job that is performed in the
workplace? YES____NO____. If "NO," explain____________________
____

3. Are all tools and equipment needed to perform the job listed? YES____
NO____. If "NO," explain____________________________________
____

4. Is the estimated time allowed for the job reasonable? YES____NO____.
If "NO," explain____
____

5. Can the job be set up and performed in the instructional facilities of most schools? YES____NO____. If "NO," explain______________________________

____

6. Are the process variables accurate, complete and reflective of industry standards? YES_____NO_____. If "NO," explain______________________________

____

7. Are the product variables accurate, complete and reflective of industry standards? YES_____NO_____. If "NO," explain______________________________

____

8. Are the instructions for the individual who is rating the student performance of the job (using process and product variables) clear and concise? YES_____NO_____. If "NO," explain______________________________

____

9. Is the performance job coded to the correct task or tasks? YES_____NO_____. If "NO," explain____

____

APPENDIX H

EDITORIAL SUMMARY RESPONSE SHEET

FORM 1 & 2

APPENDIX H

Editorial Summary Response Sheet (form 1)

Occuaption____________________________

	SME's						
Item Number	1	2	3	4	5	6	7
1	a	a	a	a	b	b	b
↓	c	c	b	a	a	a	a
	d	d	d	d	d	d	d
	c	c	c	c	c	c	c
N							

Editorial Summary Response Sheet (form 2)

Occupation____________________________

Item Number	Suggestions for item stem improvement	Suggestions for distractor improvement	Other suggestions for improvement
1			
2			
3			
↓			
N			

APPENDIX I

RANDOM SELECTION OF TEST ITEMS

APPENDIX I

238 Randomly Selected Test Items for Use in Field Test on 180 Students

SHEET METAL

Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one which is best in each case.

1. 100% machinability means:

    a. metal is very easy to cut
    b. metal is very difficult to cut
    c. tool angles can be less accurate
    d. back rake must be negative

2. It would be best to strike a hardened surface with a:

    a. match
    b. chisel
    c. soft-faced hammer
    d. hardened steel hammer

3. A metal is considered non-ferrous when it:

    a. contains iron
    b. contains little or no iron
    c. is a mixture of two or more metals
    d. contains road salt

4. A metal is considered ferrous when it:

    a. contains iron
    b. contains little or no iron
    c. is a mixture of two or more metals
    d. contains a base metal

5. A metal is called an alloy when it:

   a. contains iron
   b. contains little or no iron
   c. contains two or more metals
   d. weighs at least 25 lbs.

6. If the "nominal" dimension on a drawing is 5.000 and the high limit is 5.005 and the low limit is 4.995, what is the tolerance?

   a. ± .0005

   b. ± .5

   c. ± .05

   d. ± .005

7. Hidden edge lines are represented on a drawing by a series of:

   a. lines broken by a space twice the length of the line
   b. lines broken by a space half the length of the line
   c. unbroken parallel lines
   d. lines broken by a space greater than the length of the line

8. When the word "tolerance" is used in reference to a blueprint it means:

   a. the amount of variation permitted in the size of a part
   b. designation of size without specification of limits
   c. basic or nominal size
   d. the exact theoretical size from which all limiting variations are made

9. What does a ± mean on a sheet metal pattern?

   a. the line is correctly placed
   b. there is a hem to be made
   c. there is a seam to be made
   d. there is a bend to be made

10. Templates are also known as:

    a. stretchouts
    b. paper patterns
    c. master patterns
    d. a & c

11. Spot welding is a form of:

    a. arc welding
    b. gas welding
    c. resistance welding
    d. MIG welding

12. Sheet metal screws:

    a. are self-taping
    b. always have 14 threads per inch
    c. always have slotted heads
    d. are never threaded the full length of the screw

13. A 10-24 screw:

    a. is size 24
    b. has 10 threads per inch
    c. weighs 10 lbs. per 24 screws
    d. has 24 threads per inch

14. The operation of corrugating one end of a sheet metal pipe so that it will fit easily into another pipe of the same size is called:

    a. reducing
    b. shrinking
    c. crimping
    d. seaming

15. Which of the following tools should be used to cut a long straight edge on a sheet metal pattern?

    a. squaring sheer
    b. aviation snips
    c. combination snips
    d. pliers

16. Which of the following tools should be used to turn an edge on the end of a sheet metal cylinder?

    a. mallet
    b. hammer
    c. drop hammer
    d. bumping hammer

17. What feature of aviation snips make it possible to cut metal with less effort than with tin snips?

    a. longer handles
    b. sharper blades
    c. compound levers
    d. serrated cutting edges

18. A full size drawing of the shape of the flat sheet needed to make a sheet metal object is called a:

    a. stretchout
    b. sketch
    c. pattern
    d. stretchout or pattern

19. What can happen to the edge of a piece of sheet metal that is cut when there is too much clearance for the blades of the squaring shears?

    a. it is beveled
    b. it has a rounded corner
    c. it has a square cut
    d. it has a burr

20. Which of the following machines is used to make seams?

    a. drill press
    b. hammer and mallet
    c. box and pan brake
    d. seam maker

21. Which of the following is used to form sheet metal over stakes?

    a. mallet
    b. raising hammer
    c. setting hammer
    d. hand dolly

22. The most commonly used mechanical seam, sometimes called the "hammer lock" or "hobo lock" is the:

    a. grooved seam
    b. standing seam
    c. Pittsburgh seam
    d. bottom double seam

23. A center punch should be ground to what angle?

    a. 15 °
    b. 30 °
    c. 60 °
    d. 45 °

24. Which of the following can be used to square sheet metal?

    a. set squares
    b. trammels
    c. squaring shears
    d. squaring tools

25. Which of the following tools is used to check the squareness of a piece of sheet metal?

    a. combination square
    b. framing square
    c. try square
    d. all of the above

26. What is the first step in squaring a sheet of metal?

    a. lay out a square on the metal
    b. scribe a set of perpendicular reference lines
    c. make approximate cuts and square with a file
    d. use the hawk billed snips to trim the metal

27. What is the maximum thickness that should be cut with tin snips?

    a. 16 gauge
    b. 20 gauge
    c. 22 gauge
    d. 24 gauge

28. When making straight cuts with tin snips, it is best to:

    a. keep the jaws 30° to the metal
    b. use the full length of the blade for cutting
    c. start the cut in the throat of the snip jaws
    d. start the cut in the throat of the snip jaws and cut almost to the end

29. Which of the following is a hand operated machine that cuts a 90° notch in sheet metal?

    a. squaring shear
    b. coper
    c. notcher
    d. squaring punch

30. What is usually used to clean soldering coppers before soldering?

    a. nitric acid
    b. sal soda
    c. sal ammoniac
    d. muriatic acid

31. Solder that is 50/50 is made of:

    a. half lead and half antimony
    b. hald tin and half zinc
    c. half zinc and half antimony
    d. half tin and half lead

32. Joints soldered with a corrosive flux must be:

    a. annealed
    b. cleaned with water
    c. brushed
    d. tempered

33. Soldering is the process of:

    a. melting two bare metals together
    b. melting one bare metal to a parent metal
    c. joining two metals with a metal of lower melting temperature
    d. welding soft metals

34. Tinning refers to the process of:

    a. adding a light coat of solder to the copper
    b. finishing the surfaces flat
    c. shaping the copper to a point
    d. applying sal ammoniac to the tip of the copper

35. Metal which is to be hand riveted should:

    a. be brittle
    b. have low tensile strength
    c. be ductile
    d. have a high melting point

36. Which of the following is a machine used to draw rivets tight in two pieces of sheet metal?

    a. dolly bar
    b. hand seamer
    c. crimper
    d. rivet set

37. Which of the following rivets should be used when a riveted galvanized sheet steel joint is to be soldered?

    a. black iron rivet
    b. tinned rivet
    c. solid copper rivet
    d. hollow rivet

38. Which of the following hand tools is used to make hems, seams, and other straight line bends in thin sheet metal?

    a. hand groover
    b. hand seamer
    c. hand bender
    d. hand former

MACHINE SHOP

Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one which is best in each case.

1. One-thousandth of an inch in decimal form is:

   a. 0.1 inch
   b. 0.01 inch
   c. 0.001 inch
   d. 0.0001 inch

2. The outside micrometer caliper is made of several parts that are all held by:

   a. an anvil
   b. a lock
   c. a barrell
   d. a frame

3. The special scale on the sleeve of mocrometers which increases the accuracy of measurements ten fold is called a:

   a. metric scale
   b. decimal scale
   c. fractional scale
   d. vernier scale

4. What part of the micrometer controls the amount of pressure on the spindle when making measurements?

   a. ratchet
   b. thimble
   c. lock nut
   d. anvil

5. How many graduations are found on metric micrometer thimbles?

   a. 10
   b. 25
   c. 50
   d. 100

6. A standard micrometer has a discrimination of what part of an inch:

   a. .001
   b. .010
   c. .011
   d. .0001

7. Gauge blocks used to check or set angle to minutes of accuracy are called:

   a. height gauges
   b. indicator bars
   c. sine bars
   d. surface gauges

8. Which of the following instruments is often used with gauge blocks to establish precise angles?

   a. optical collinator
   b. abney level
   c. sine bar
   d. vernier bevel protractor

9. When layout lines must be accurate to within .001 inches, a machinist should use the:

   a. surface gauge method
   b. vernier height gauge method
   c. combination set method
   d. trammel point method

10. The tool used to layout a parallel line to a shoulder or edge of a workpiece is called a:

   a. compass
   b. divider
   c. hermaphrodite caliper
   d. scribe

11. When using a combination set for laying out a 45° angle, the blade should be mounted on the:

a. square head
b. protractor head
c. center head
d. depth gauge attachment

12. When scribing perpendicular lines, the workpiece must be:

a. inverted
b. turned 90 degrees
c. left as is and the height gauge used on an angle plate
d. set on a parallel bar

13. Angle plates are used in layout work for:

a. holding the work parallel
b. holding the layout tool
c. holding the work for prick punching
d. supporting the surface plate

14. Why are layout lines prick punched after they are scribed?

a. to make the layout lines more visible
b. to determine the starting point of the layout
c. to detrmine the finishing point of the layout
d. to prevent destroying the layout line

15. Which of the following is a tool for cleaning files?

a. brush card
b. bench brush
c. file card
d. emery cloth

16. Which of the following in not part of a file?

a. tip
b. heel
c. face
d. tang

17. Which of the following would be used to smooth file a piece of flat stock?

    a. single-cut file
    b. double-cut file
    c. rasp file
    d. vixen file

18. A file is made of:

    a. mild steel
    b. alloy steel
    c. tungsten
    d. high-carbon steel

19. Draw filing is performed to:

    a. remove stock quickly
    b. produce a smooth finish
    c. use the full length of the file
    d. remove burrs

20. What can be applied to the face of a file to prevent chips from clogging the teeth?

    a. chalk
    b. oil
    c. water
    d. powder

21. The width of the cut made by a saw blade is called the:

    a. clearance
    b. allowance
    c. kerf
    d. gauge

22. What is the best position for your feet when using the hacksaw?

    a. feet together
    b. feet far apart
    c. feet apart and pointing toward the work
    d. feet apart and pointing at a 90° angle to the work

23. What is the recommended cutting speed for the hand hacksaw?

a. 40 strokes per minute
b. 60 strokes per minute
c. 80 strokes per minute
d. 90 strokes per minute

24. The blade of a hand hacksaw makes a cut wider than the blade because:

a. the blade locks sideways
b. the teeth have kerf
c. the teeth have set
d. all of the above

25. The number of teeth per inch of blade is called the:

a. clearance angle
b. off set
c. pitch
d. tooth

26. Which of the following is used to thread an open or through hole:

a. tapered tap
b. plug tap
c. bottom tap
d. pointed tap

27. The tap drill must be slightly larger than which of the following thread diameters?

a. major
b. minor
c. mean
d. exterior

28. A small tap is held with a:

a. straight handle wrench
b. T-handled wrench
c. small wrench
d. adjustable wrench

29. Which of the following tools is used to determine whether a tap is started straight?

    a. plumb
    b. square
    c. divider
    d. sliding T-bevel

30. The size of a tap is stamped on the:

    a. end
    b. top
    c. flute
    d. shank

31. Which of the following taps is used to thread a blind hole?

    a. plug tap
    b. pointed tap
    c. tapered tap
    d. bottom tap

32. A die is "backed off" in order to:

    a. give the die a running start at the metal to be removed
    b. straighten the thread
    c. break the chip
    d. allow the cutting oil to run ahead of the die

33. Which of the following tools is used to determine if a die is straight?

    a. machinists square
    b. spitit level
    c. protractor
    d. plumb bob

34. A round split die is expanded and contracted by a:

    a. tapered wedge
    b. nut
    c. screw
    d. carriage bolt

35. The handle used on a hand die is called a:

    a. crescent wrench
    b. tap wrench
    c. die stock
    d. die plate

36. The margin of the drill is:

    a. two or more helical grooves, cut around the body of the drill
    b. the undercut portion of the body
    c. the narrow, raised section on the body of the drill next to the flutes extending the length of the flutes
    d. the thin partition in the center of the drill extending the full length of the flutes

37. The size of a drill press is determined by the:

    a. largest size drill that will fit the machine
    b. highest velocity the drill will rotate
    c. distance from the edge of the column to the center of the spindle
    d. weight of the machine

38. The quill spindle on a drill press is a round shaft which holds the:

    a. chuck
    b. table
    c. motor
    d. head

39. The feed handle of a drill press:

    a. had 6 speeds
    b. controls the up and down movement
    c. holds tools up to 13 mm in diameter
    d. can be set to spin around the column

40. The drill chuck of a drill press:

    a. is used to drill holes through the table
    b. holds drill bits and other tools
    c. has a capacity from 1/2 inch to 13 mm
    d. fits into 3 holes in the body

41. A drift is the:

    a. amount the drill shifts from the centered hole
    b. tool used to remove the drill from the spindle
    c. amount of taper from one end of a hole to the other end
    d. sleeve into which a drill fits

42. The most commonly used drill is the:

    a. twist drill
    b. core drill
    c. straight fluted drill
    d. high helix drill

43. When making a punch mark for the drill to pick up, it is best to use a:

    a. prick punch
    b. center punch
    c. chisel punch

44. If the operating speed of a drill is too fast, it will cause:

    a. the web to split
    b. the drill to penetrate the work very slowly
    c. the outer corners of the drill to wear away quickly
    d. the drill to gall

45. To drill a 1/2 inch hole in a piece of machine steel at a speed of 80 F.P.M., at what RPM should the drill press be operated?

    a. 610-640 RPM
    b. 755-800 RPM
    c. 428-450 RPM
    d. 1000-1050 RPM

46. A countersink is used for:

    a. making seats for flat head screws
    b. drilling holes in counters
    c. enlarging a hole to recess a bolt head
    d. none of the above

47. The name of the operation that makes holes larger and to an exact size is:

    a. drilling
    b. reaming
    c. boring
    d. sizing

48. A counterbore is used for:

    a. making seats for flat head screws
    b. enlarging holes to recess a bolt head
    c. boring holes in counters
    d. none of the above

49. Which of the following tools is used to resurface the face of the grinding wheel?

    a. wheel conditioner
    b. wheel dresser
    c. wheel resurfacer
    d. wheel smoother

50. Flat work for surface grinding is usually held by a:

    a. four-jaw chuck
    b. face plate
    c. magnetic chuck
    d. three-jaw chuck

51. The table stops on a surface grinder should always be set to give:

    a. 1-1/2 inches override on each end of the workpiece
    b. 1 inch override on each end of the workpiece
    c. 1/2 inch override on each end of the workpiece
    d. 2 inches override on each end of the workpiece

52. The depth of a finishing cut for a small surface grinder should be:

a. .010 to .015 inch
b. .001 to .002 inch
c. .003 to .005 inch
d. .005 to .010 inch

53. What control on the lathe is used to fix the screw pitch?

a. half nut lever
b. feed change lever
c. trembler levers
d. feed reverse levers

54. The wheel of a surface grinder should be dressed and trued with a:

a. diamond wheel dresser
b. wheel dresser
c. cutting tool
d. stone

55. Vibration while using the surface grinder may be caused by:

a. the wheel vibrator
b. a wheel that it too soft
c. an unbalanced wheel
d. dirty coolant

56. The tool rest on the grinder should be set so that it is in line with:

a. the horizontal axis
b. the vertical axis
c. the center of the grinding wheel
d. the center of the workpiece

57. A cutting tool should be cooled as it is ground in order to prevent:

a. damaging the wheel
b. burning the operator
c. melting the metal
d. drawing the temper

58. Pedestal grinders with aluminum-oxide wheels should not be used to grind:

a. drills
b. iron or steel
c. aluminum or brass
d. punches and chisels

59. What should be used to clean the lathe?

a. soap and water
b. paint remover
c. kerosene
d. air pressure

60. The tool post on a lathe is directly connected to the:

a. compound rest
b. cross slide
c. carriage
d. ways

61. The carriage of the lathe rides on the:

a. headstock
b. tailstock
c. ways
d. column

62. Chips on the lathe should be removed with a:

a. brush
b. rag
c. cloth rag
d. sponge

63. The independent chuck has:

a. four jaws that move at the same time
b. four jaws that move independently
c. a special adjusting system
d. three jaws that move independently

64. The most accurate method of securing the work in an independent chuck is to use:

a. concentric circles
b. the point of the cutting tool
c. a piece of chalk
d. a dial indicator

65. The lathe term "feed rate" indicates the rate at which the:

a. spindle turns
b. tailstock moves
c. carriage moves
d. headstock moves

66. When center drilling on the lathe, the drill can be mounted in the head stock or in the:

a. tailstock
b. tool post holder
c. boring bar
d. center rest

67. The best method of locating the center of round piece of work is with the:

a. inside calipers
b. outside calipers
c. screw pitch gauge
d. center head

68. Work to be turned between centers requires that the ends be drilled with suitable holes for a:

a. cutting tool
b. lathe center
c. tailstock
d. compound rest

69. Which lathe tool drives or turns the workpiece when machining between centers?

    a. dog
    b. chuck
    c. line center
    d. mandrel

70. Counterboring involves boring and:

    a. countersinking
    b. turning outside shoulders
    c. facing internal shoulders
    d. spot facing

71. Drills smaller than 1/2 inch are:

    a. not used on the lathe
    b. held in a jacob's chuck
    c. held in the tailstock spindle
    d. held in a drill holder

72. Which of the following lathe operations is performed in order to provide a tapered hole for a flat head screw?

    a. center drill
    b. counterbore
    c. countersink
    c. ream

73. What kind of operation is knurling?

    a. forming
    b. cutting
    c. shaping
    d. slotting

74. Knurling on metal handles provides:

    a. better grip
    b. a longer lasting part
    c. a better part
    d. no significant improvement

75. Which part of the lathe has knurled parts?

  a. quick change gear box
  b. leadscrew
  c. micrometer collar
  d. apron

76. Knurls make a pattern on the workpiece by:

  a. cutting the material
  b. displacing the material
  c. compressing the material
  d. removing the material

77. Which of the following controls is used with a thread dial indicator?

  a. half nut lever
  b. feed change lever
  c. clutch knob
  d. feed reverse lever

78. When threading on a lathe, the compound rest is set at:

  a. 19°
  b. 39°
  c. 29°
  d. 27°

79. Why must a thread chasing dial be used when cutting threads?

  a. to regualte the lathe speed
  b. to determine the number of threads
  c. to give the right thread angle
  d. to determine when to close the half nut for a repeat cut

80. The half nut lever on a lathe is used for:

  a. engaging the longitudinal feed on the carriage
  b. taking up the slack in the cross slide nut
  c. changing from longitudinal to cross feed
  d. threading

81. The standard V thread is:

    a. 30°
    b. 45°
    c. 60°
    d. 75°

82. Threads are cut or chased on a lathe with a single point tool by:

    a. taking a series of cuts in the same groove
    b. taking only trial cuts
    c. using a thread die
    d. using a taper attachment

83. When threading on a lathe, the tool bit is aligned with the workpiece using a:

    a. center gauge
    b. screw pitch gauge
    c. thread gauge
    d. tool blank

84. Matching tapers can be turned and bored readily by swiveling the:

    a. compound
    b. tool holder
    c. guide bar
    d. tailstock

85. Which method of taper turning is best suited for machining a 60° lathe center point?

    a. tailstock set over
    b. compound rest
    c. taper attachment
    d. carriage set over

86. When using the taper attachment, the power feed should be engaged at least 1 inch before the start of the cut in order to:

a. allow for expansion of the workpiece
b. remove any play in the taper attachment
c. get a smooth start
d. all of the above

87. When turning a taper on the lathe, it is important to set the cutting tool:

a. slightly above center
b. slightly below center
c. on center
d. at a right angle to center

88. The purpose of the edge finder on the milling machine is to:

a. help maintain squareness of the workpiece
b. locate holes
c. mill sides of a workpiece
d. allow the operator to locate the exact position for the machining operation

89. The best way to remove excess chips from the milling machine is with:

a. an air hose
b. a brush
c. rags
d. with the hands

90. The recommended cleaning fluid for cleaning a milling machine is :

a. gasoline
b. diesel fuel
c. mineral spirits
d. carbon tetrachloride

91. The knee on the vertical milling machine can be moved up and down by:

    a. power feed
    b. rapid traverse
    c. turning the elevating crank handle
    d. turning the cross feed handle

92. The most common work holding device for the milling machine is:

    a. clamps
    b. dividing head
    c. vise
    d. T-bolts

93. which of the following is used to insure proper alignment of the milling head?

    a. square
    b. dial indicator
    c. Go or No Go gauge
    d. micrometer

94. Mill heads are graduated in:

    a. inches
    b. feet
    c. millimeters
    d. degrees

95. Proper alignment of the vertical head is important because:

    a. the workpiece may be out of round
    b. drilled holes could be oversize
    c. it insures flatness, squareness, and perpendicularity
    d. it allows greater tolerance

96. The depth of any standard keyseat is always:

    a. twice the cutter width
    b. 1/2 the cutter width
    c. 1/3 the cutter width
    d. 1/4 the cutter width

97. The size of a keyway is determined by the:

a. diameter of the shaft
b. length of the shaft
c. diameter of the cutter
d. all of the above

98. The most precise way to locate a cutter centrally over a shaft is:

a. with a spirit level
b. by trial and error
c. position with the cross feed dial when the cutter touches the work
d. determine the radius of the shaft

99. The size of the shaper is determined by the:

a. length of the stroke of the ram
b. largest cube of metal that can be machined
c. amount of horizontal movement of the table
d. amount of vertical movement of the table

100. What factors affect the cutting speed used on a shaper?

a. tool material
b. work material
c. kind of cut made
d. all of the above

WELDING

Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one which is best in each case.

1. What would be the probable effect if oil or grease were allowed to come in contact with oxygen in the regulators or cylinders?

   a. the valves would turn smoother
   b. a highly explosive mixture could be formed
   c. the gases would flow faster
   d. there would be no effect

2. All regulators have two gauges; one indicates the pressure in the cylinder and the other the:

   a. back at the tip
   b. working or line pressure
   c. temperature of the acetylene
   d. temperature of the oxygen

3. Which one of the following parts is not part of the oxyacetylene torch body and cutting attachment?

   a. tip nut
   b. slip-in tip
   c. cutting orifice
   d. electrode

4. The distance between the end of the electrode wire and the end of the contact tip is called the:

   a. kerf
   b. stick out
   c. electrode gap
   d. power range

5. The torch pressure of acetylene should always be kept below:

   a. 25 psig
   b. 50 psig
   c. 15 psig
   d. 75 psig

6. The red welding hose usually carries:

   a. air
   b. acetylene
   c. oxygen
   d. carbon

7. The acetylene hose nipple nuts have:

   a. left-handed threads
   b. right-handed threads
   c. smooth threads
   d. coarse threads

8. An effective procedure to check for leaks in an oxyacetylene system is to test the connections with:

   a. water
   b. oil
   c. flame
   d. soapsuds

9. The purpose of a regulator on an oxyacetylene cutting torch is to reduce cylinder pressures to torch pressures and to:

   a. keep the pressures constant
   b. control the torch movement
   c. mix the oxygen and acetylene gases
   d. separate the oxygen and acetylene gases

10. The hoses on oxyacetylene cutting equipment are color coded. What color is the oxygen hose?

   a. black or blue
   b. black or red
   c. black or green
   d. black or yellow

11. Ferrous metals can be cut with a gas flame because they:

   a. oxidize quickly
   b. conduct heat faster
   c. conduct heat more slowly
   d. none of the above

12. A process by which iron or steel is heated to a temperature that rapidly oxidizes by high purity oxygen flowing under pressure through a cutting torch is called:

    a. flame cutting
    b. melt cutting
    c. combustion cutting
    d. automatic cutting

13. What process takes place when metal is cut?

    a. penetration
    b. percussion
    c. oxidation
    d. inductance

14. The width of a cut produced by the flame cutting operation is a:

    a. lap
    b. kerf
    c. pass
    d. cleft

15. When a specific type of material is to be cut, what determines the size of the cutting tip?

    a. the hardness
    b. the thickness
    c. the roundness
    d. the flatness

16. Oxyacetylene cutting equipment cannot be used to cut:

    a. low carbon steel
    b. aluminum
    c. channel iron
    d. high strength steel

17. When shutting the torch off, which needle valve should be closed first?

    a. oxygen
    b. acetylene
    c. nitrogen
    d. hydrogen

18. Flame cutting is often used in:

    a. steel fabrication
    b. construction
    c. demolition work
    d. all of the above

19. To prevent incorrect and dangerous assembly of the hoses to the tanks or to the cutting torch, the fuel hose has fittings that:

    a. are larger than the oxygen hose fittings
    b. have left hand threads
    c. have tapered pipe threads
    d. are smaller than the oxygen hose fittings

20. When a torch is lighted, the oxygen valve is:

    a. closed
    b. open
    c. turned on and off quickly
    d. disconnected

21. The amount of oxygen required for cutting operations is:

    a. less than that required for welding
    b. the same as that required for welding
    c. more than that required for welding
    d. none of the above

22. Nonferrous metals cannot be flame cut because they contain little or no:

    a. steel
    b. iron
    c. tin
    d. copper

23. What compound is brought into contact with water to form acetylene gas?

    a. calcium carbide
    b. carbon dioxide
    c. mappgas
    d. helium hydrogen

24. Acetylene is stable under low pressures; however, it becomes dangerous if compressed to more than:

    a. 15 lbs. per sq. in.
    b. 10 lbs, per sq. in.
    c. 6 lbs. per sq. in.
    d. 4 lbs. per sq. in.

25. An approximate one-to-one mixture of acetylene and oxygen produces a:

    a. carbonizing flame
    b. neutral flame
    c. reducing flame
    d. medium flame

26. Heating steel above the temperature used for annealing and then cooling it in still air at room temperature is called:

    a. deoxidizing
    b. deep etching
    c. normalizing
    d. degassing

27. The proper tip travel angle when welding in the flat position is:

    a. 45° to 60° with plate
    b. 15° to 30° with plate
    c. 10° to 35° with plate
    d. 60° to 75° with plate

28. What kind of process is nitriding?

    a. case-hardening
    b. annealing
    c. welding
    d. soldering

29. When a torch is ignited, the tip should be facing:

    a. downward
    b. upward
    c. to the left
    d. to the right

30. The main purpose of a filler rod is to:

    a. add strength to weld on joint
    b. fill in gaps
    c. use on auto body work
    d. weld copper tubing

31. Acetylene is produced when water is mixed with:

    a. hydrogen
    b. acetone
    c. quicklime
    d. calcium carbide

32. The output of an arc welding machine is stated in:

    a. amperage
    b. resistance
    c. ohms
    d. voltage

33. The gases are flowing too slowly through the tip, and they are burning faster than the speed at which they flow out of the tip. This condition is usually caused by:

    a. touching the tip to the work
    b. an overheated tip
    c. the torch being operated at lower pressure than that required for tip size used
    d. a loose tip or head

34. A cleaning agent used to dissolve oxides, release trapped gasses and slag and cleanse metal surfaces for welding, soldering, and brazing is called:

    a. metal cleaner
    b. dissolver
    c. flux
    d. fluid cleaner

35. Why should you have a clean metal surface in braze welding?

    a. heat will be released easier
    b. to have a stronger bond on base metal
    c. keeps metal from piling up
    d. penetration will be easier

36. A short weld used for temporarily holding material in place is a:

    a. short weld
    b. thin weld
    c. tack weld
    d. plug weld

37. Softening metals by heat treatment is called:

    a. welding
    b. brazing
    c. chamfering
    d. annealing

38. In order to strike an arc there must be:

    a. ample ventilation
    b. a ground clamp
    c. an electrode holder
    d. a complete circuit

39. When setting up an arc welding machine, what two factors determine the setting?

    a. electrode size and weather conditions
    b. right hand and left hand
    c. type of machine and length of weld
    d. thickness of the metal and electrode size

40. Most welding cables are made of:

    a. aluminum
    b. copper
    c. nickel
    d. magnesium

41. One of the purposes of flux on electrodes is to:

    a. stabilize the arc
    b. make the arc starting difficult
    c. keep the electrodes cool
    d. all of the above

42. What type of welding machine only produces an AC current?

    a. rectifier
    b. generator
    c. transformer
    d. all welding machines

43. What is the polarity when the electrode is positive?

    a. straight
    b. balanced
    c. reverse
    d. forward

44. How is the size of an arc welding machine determined?

    a. maximum output amperage
    b. height, width, and length
    c. the machine weight
    d. the size of the motor

45. Soapstone is used to:

    a. wash hands
    b. clean electrodes
    c. draw lines on a steel plate
    d. clean ground clamps

46. There are two methods of striking an arc. One is tapping, the other is:

    a. dragging
    b. whipping
    c. scratching
    d. pecking

47. When restarting a continuous bead, the existing crater must be filled or the bead:

    a. will not look good
    b. will be too wide
    c. will expand
    d. will be weak at that point

48. When welding out of position, the molten puddle is:

    a. smaller
    b. deeper
    c. larger
    d. affected by the force of gravity

49. Which of the following is a factor that determines weld quality?

    a. amperage
    b. length of the arc
    c. speed of travel
    d. all of the above

50. Which of the following electrodes is most similiar to the E6010?

    a. E7018
    b. E6011
    c. E6012
    d. E6013

51. To secure a strong weld, the metal deposited from the electrode must fuse completely with the:

    a. slag
    b. base metal
    c. pool
    d. craters

52. Slag should be removed by chipping:

    a. toward the body
    b. away from eyes and face
    c. toward the bottom of the work
    d. toward the top of the work

53. When the joint fit is tight and the edges are not beveled, use a:

    a. wide electrode
    b. light penetration electrode
    c. deep penetration electrode
    d. extra long electrode

54. The sound of a correct arc is like:

    a. a sputtering sound
    b. a continuous "frying" sound
    c. an intermittent thud
    d. a high pitched whine

55. What one factor determines if a joint is to have an open or closed root?

    a. bead conformity
    b. penetration
    c. speed of applicaton
    d. electrode coating

56. When the joint fit is poorly fitted or the material to be welded is light, use a:

    a. low hydrogen electrode
    b. light penetration electrode
    c. deep penetration electrode
    d. very wide iron powder electrode

57. Protrusion of weld metal beyond the bond at the toe of the weld is called:

    a. a lap joint
    b. an inclusion
    c. an overlap
    d. a mistake

58. To examine the formation of stringer beads, you must first remove the:

    a. slag
    b. ground clamp
    c. wall plug
    d. steel plate

59. Which electrode has the higher tensile strength when used with mild steel?

    a. E7014
    b. E6013
    c. E6011
    d. E6010

60. After the first pass is made on the practice plate, cool the metal in:

    a. oil
    b. kerosene
    c. soap
    d. water

61. Which of the following conditions could be produced by a crater that is not properly filled?

    a. strong weld
    b. weak weld
    c. convex weld
    d. undersize weld

62. A depression at the termination of a weld is called:

    a. a crater
    b. flux
    c. a spattr
    d. porosity

63. What length of arc should be used when welding in the horizontal position?

    a. long arc
    b. very short arc
    c. short arc
    d. very long arc

64. In order to obtain maximum strength in a lap joint, you must weld:

a. one side
b. both sides
c. back side
d. front side

65. When welding in the horizontal position, the current should be be_______________________that of welding in the flat position.

a. slightly less than
b. the same as
c. slightly greater than
d. twice

66. After the first bead is deposited on a Tee-joint, the work is turned over and a bead is placed along the opposite edge of the joint. This will prevent:

a. distortion
b. slag intrusion
c. overlapping
d. undercutting

67. It is best to pick up hot metal with:

a. gloves
b. a chipping hammer
c. tongs
d. a steel brush

68. Care must be taken that the third bead of a Tee-joint penetrates into the first and second beads as well as into the:

a. vertical plate
b. horizontal plate
c. back of the plate
d. front of the plate

69. In vertical welding, the arc must be kept very short, approximately:

a. a half diameter of the electrode
b. a full diameter of the electrode
c. twice the diameter of the electrode
d. one-half inch

70. Vertical welding is done by laying beads in an:

a. upward direction
b. downward direction
c. in an upward or downward direction
d. none of the above

71. During vertical welding, you should always keep your eye on the:

a. arc
b. electrode
c. puddle
d. selector switch

72. As you weld in the vertical position you must take care to maintain a:

a. high amp setting
b. small bead
c. constant arc length
d. none of the above

73. What is the term that is applied to the inward and upward movement of the electrode during vertical welding?

a. whipping
b. shielded metal arc welding
c. arc length
d. puddling

74. The upward welding technique is used on:

a. thick stock
b. sheet metal
c. galvanized sheet metal
d. all of the above

75. To increase the strength of a welded butt joint, a second weave bead is deposited on the:

a. metal
b. backing strip
c. weld fixture
d. root pass

76. When the first welding pass is complete, remove the backing plate and check for:

a. proper penetration of the root pass
b. inclusions
c. distortion
d. none of the above

77. How can distortion be controlled?

a. use of a smaller electrode
b. welding slower
c. using more current
d. using tack welds properly

78. What causes defects in a weld?

a. improper current setting
b. poor electrode control
c. failure to clean all beads
d. all of the above

79. While welding in the overhead positon, what length of arc should be held?

a. short
b. long
c. medium
d. very long

80. Excessive weld splatter is caused by:

a. using the wrong electrode
b. wrong electrode manipulation and too much current
c. traveling too fast
d. using too short arc

81. The tendency of different molecules to stick together is called:

a. cohesion
b. adhesion
c. surface tension
d. bonding

82. The ability of like molecules in a liquid to cohere or hold together is called:

a. cohesion
b. adhesion
c. surface tension
d. compression

83. In order to hold a short arc, you must have:

a. high amperage
b. more current and less voltage
c. sufficient amperage
d. very low amperage

84. If the puddle becomes too hot while welding thin base metal in the overhead position:

a. cut down the amperage
b. increase the amperage
c. change the electrode
d. adjust the angle of the electrode

85. Good penetration results from:

a. proper current setting
b. proper travel speed
c. proper angle of the electrode
d. all of the above

86. Most of the strength of flux-coated welds is a result of:

a. the speed at which welding takes place
b. easy visibility during the weld
c. protection of the shielding gas and deoxidizing action of the flux core
d. use of a constant current power

87. In overhead welding, a low amperage will cause:

a. low penetration
b. overhead circuits
c. burn through
d. high penetration

88. When you are standing and welding in the overhead position, where should the cable be placed?

a. under your arm
b. over your knee
c. over your shoulder
d. under your foot

89. The most difficult welding position for most welders is the:

a. flat
b. overhead
c. vertical
d. horizontal

90. Where should you stand when welding in the overhead position?

a. directly overhead
b. to the side
c. directly underneath
d. behind the welding machine

91. The flux used to cover an electrode influences:

a. welding speed
b. crater depth
c. arc penetration
d. all of the above

92. The most commonly used shield gas for TIG welding is:

a. argon
b. carbon dioxide
c. nitrogen
d. hydrogen

93. What does TIG stand for?

a. tungsten
b. gas
c. inert
d. all of the above

94. TIG welding is calld by what other name in the trade?

a. heliarc welding
b. mig welding
c. flux-coated welding
d. back hand welding

95. What are the two basic types of TIG torches?

a. water cooled and air cooled
b. short-arc and spray arc
c. longitudinal and traverse
d. none of the above

96. How long is the TIG filler wire when it is new?

a. 24 inches
b. 18 inches
c. 36 inches
d. 12 inches

97. All filler rods should be__________and_________since an oil-coated rod can cause porosity.

a. degreased, cleaned
b. strong, coated
c. tested, verified
d. none of the above

98. What type of welding machine is best suited for all types of TIG welding?

a. AC transformer
b. DC rectifier
c. AC-DC transformer-rectifier with high frequency
d. all of the above

99. The three types of electodes used for gas tungsten arc welding are thoriated, zirconiated tungsten, and:

- a. pure tungsten
- b. zinc tungsten
- c. zinc
- d. tungsten carbonate

100. Where is the filler wire applied to the puddle?

- a. center
- b. back edge
- c. leading edge
- d. none of the above

APPENDIX J

TEST ITEM RESULTS FORMAT

APPENDIX J

Test Item Results

Schools

Item Number	1 wrong/n	2 w/n	3 w/n	4 w/n	5 w/n	6 w/n	7 w/n
1							
2							
3							
4							
5							
100							
Total							

Wrong = total number of students answering the question incorrectly in a school.

N = total number of students responding to the item by school

APPENDIX K

CODING FORMAT

APPENDIX K

CODING FOR TEST ITEM DEVELOPMENT

CIP (1)	DOT (2)	Occupation Title (3)	
Duty (4)	Task (5)	Perf. Objective (6)	Domain (7)
State of Origin (8)	Date Submitted (9)	Last Revised (10)	

(1) CIP Code

(2) DOT Code(s)

(3) Occupational Title or Catalog Title

(4) Duty

(5) Task

(6) Performance Objective

(7) Domain - Cognitive C1 = Recall, verbal information
C2 = Application of knowledge
Affective A
Psychomotor P

(8) State which submitted item

(9) Date originally submitted

(10) Date of last revision

(11) Graphics

APPENDIX L

TEST ITEMS

WELDING

W1. What would be the probable effect if oil or grease were allowed to come in contact with oxygen in the regulators or cylinders?

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c. cutting orifice
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W4. The distance between the end of the electrode wire and the end of the contact tip is called the:

a. kerf
b. stick out
c. electrode gap
d. power range

W5. The torch pressure of acetylene should always be kept below:

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b. 50 psig
c. 15 psig
d. 75 psig

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b. acetylene
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W7. The acetylene hose nipple nuts have:

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c. smooth threads
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b. oil
c. flame
d. soapsuds

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b. thickness
c. roundness
d. flatness

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b. aluminum
c. channel iron
d. high strength steel

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c. nitrogen
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b. construction
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d. 60° to 75° with plate

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b. annealing
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b. upward
c. to the left
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W40. What type of welding machine only produces an AC current?

a. rectifier
b. generator
c. transformer
d. all welding machines

W41. What is the polarity when the electrode is positive?

a. straight
b. balanced
c. reverse
d. forward

W42. How is the size of an arc welding machine determined?

a. maximum output amperage
b. height, weight, and length
c. machine weight
d. size of the motor

W43. Soapstone is used to:

a. wash hands
b. clean electrodes
c. draw lines on a steel plate
d. clean ground clamps

W44. There are two methods of striking an arc. One is tapping, the other is:

a. dragging
b. whipping
c. scratching
d. pecking

W45. When restarting a continuous bead, the existing crater must be filled or the bead will:

a. not look good
b. be too wide
c. expand
d. be weak at that point

W46. When welding out of position, the molten puddle is:

a. smaller
b. deeper
c. larger
d. affected by the force of gravity

W47. Which of the following is a factor that determines weld quality?

a. amperage
b. length of the arc
c. speed of travel
d. all of the above

W48. Which of the following electrodes is most similiar to the E6010?

a. E7018
b. E6011
c. E6012
d. E6013

W49. To secure a strong weld, the metal deposited from the electrode must fuse completely with the:

a. slag
b. base metal
c. pool
d. craters

W50. Slag should be removed by chipping:

a. toward the body
b. away from the body
c. toward the bottom of the work
d. toward the top of the work

W51. When the joint fit is tight and the edges are not beveled, use a:

a. wide electrode
b. light penetration electrode
c. deep penetration electrode
d. extra long electrode

W52. The sound of a correct arc is like:

a. a sputtering sound
b. a continuous "frying" sound
c. an intermittent thud
d. a high pitched whine

W53. What one factor determines if a joint is to have an open or closed root?

a. bead conformity
b. penetration
c. speed of application
d. electrode coating

W54. When a joint is poorly fitted, or the material to be welded is light, use a:

a. low hydrogen electrode
b. light penetration electrode
c. deep penetration electrode
d. very wide iron powder electrode

W55. Protrusion of weld metal beyond the bond at the toe of the weld is called:

a. a lap joint
b. an inclusion
c. an overlap
d. a mistake

W56. To examine the formation of stringer beads, you must first remove the:

a. slag
b. ground clamp
c. wall plug
d. steel plate

W57. Which electrode has the higher tensile strength when used with mild steel?

a. E7014
b. E6013
c. E6011
d. E6010

W58. After the first pass is made on a practice plate, cool the metal in:

a. oil
b. kerosene
c. soap
d. water

W59. Which of the following conditions could be produced by a crater that is not properly filled?

a. strong weld
b. weak weld
c. convex weld
d. undersize weld

W60. A depression at the termination of a weld is called:

a. a crater
b. flux
c. a spatter
d. porosity

W61. What length of arc should be used when welding in the horizontal position?

a. long arc
b. very short arc
c. short arc
d. very long arc

W62. In order to obtain maximum strength in a lap joint, you must weld:

a. one side
b. both sides
c. back side
d. front side

W63. When welding in the horizontal position, the current should be________________________that of welding in the flat position.

a. slightly less than
b. the same as
c. slightly greater than
d. twice

W64. After the first bead is deposited on a Tee-joint, the work is turned over and a bead is placed along the opposite edge of the joint. This will prevent:

a. distortion
b. slag intrusion
c. overlapping
d. undercutting

W65. It is best to pick up hot metal with:

a. gloves
b. a chipping hammer
c. tongs
d. a steel brush

W66. Care must be taken that the third bead of a Tee-joint penetrates into the first and second beads as well as into the:

a. vertical plate
b. horizontal plate
c. back of the plate
d. front of the plate

W67. In vertical welding, the arc must be kept very short, approximately:

a. a half diameter of the electrode
b. a full diameter of the electrode
c. twice the diameter of the electrode
d. one-half inch

W68. Vertical welding is done by laying beads in an:

a. upward direction
b. downward direction
c. in an upward or downward direction
d. none of the above

W69. During vertical welding, you should always keep your eye on the:

a. arc
b. electrode
c. puddle
d. selector switch

W70. As you weld in the vertical position you must take care to maintain a:

a. high amp setting
b. small bead
c. constant arc length
d. none of the above

W71. What is the term that is applied to the inward and upward movement of the electrode during vertical welding?

a. whipping
b. shielded metal arc welding
c. arc length
d. puddling

W72. The upward welding technique is used on:

a. thick stock
b. sheet metal
c. galvanized sheet metal
d. all of the above

W73. To increase the strength of a welded butt joint, a second weave bead is deposited on the:

a. metal
b. backing strip
c. weld fixture
d. root pass

W74. When the first welding pass is complete, remove the backing plate and check for:

a. proper penetration of the root pass
b. inclusions
c. distortion
d. none of the above

W75. How can distortion be controlled?

a. use of a smaller electrode
b. welding slower
c. using more current
d. using tack welds properly

W76. What causes defects in a weld?

a. improper current setting
b. poor electrode control
c. failure to clean all beads
d. all of the above

W77. While welding in the overhead position, what length of arc should be held?

a. short
b. long
c. medium
d. very long

W78. Excessive weld splatter is caused by:

a. using the wrong electrode
b. wrong electrode manipulation and too much current
c. traveling too fast
d. using too short arc

W79. The tendency of different molecules to stick together is called:

a. cohesion
b. adhesion
c. surface tension
d. bonding

W80. The ability of like molecules in a liquid to cohere or hold together is called:

a. cohesion
b. adhesion
c. surface tension
d. compression

W81. In order to hold a short arc, you must have:

a. high amperage
b. more current and less voltage
c. sufficient amperage
d. very low amperage

W82. If the puddle becomes too hot while welding thin base metal in the overhead position:

a. cut down the amperage
b. increase the amperage
c. change the electrode
d. adjust the angle of the electrode

W83. Good weld penetration results from:

a. proper current setting
b. proper travel speed
c. proper angle of the electrode
d. all of the above

W84. Most of the strength of flux-coated welds is a result of:

a. the speed at which welding takes place
b. easy visibility during the weld
c. protection of the shielding gas and deoxidizing action of the flux core
d. use of a constant current power

W85. When welding in the overhead position, low amperage will cause:

a. low penetration
b. overhead circuits
c. burn through
d. high penetration

W86. When you are standing and welding in the overhead position, where should the cable be placed?

a. under your arm
b. over your knee
c. over your shoulder
d. under your foot

W87. The most difficult welding position for most welders is the:

a. flat position
b. overhead position
c. vertical position
d. horizontal position

W88. Where should you stand when welding in the overhead position?

a. directly overhead
b. to the side of the weld
c. directly underneath the weld
d. behind the welding machine

W89. The flux used to cover an electrode influences:

a. welding speed
b. crater depth
c. arc penetration
d. all of the above

W90. The most commonly used shield gas for TIG welding is:

a. argon
b. carbon dioxide
c. nitrogen
d. hydrogen

W91. What does TIG stand for?

a. tungsten
b. gas
c. inert
d. all of the above

W92. TIG welding is called by what other name in the trade?

a. heliarc welding
b. mig welding
c. flux-coated welding
d. back hand welding

W93. What are the two basic types of TIG torches?

a. water cooled and air cooled
b. short-arc and spray arc
c. longitudinal and traverse
d. none of the above

W94. How long is the TIG filler wire when it is new?

a. 24 inches
b. 18 inches
c. 36 inches
d. 12 inches

W95. All filler rods should be__________and__________since an oil-coated rod can cause porosity.

a. degreased, cleaned
b. strong, coated
c. tested, verified
d. none of the above

W96. What type of welding machine is best suited for all types of TIG welding?

a. AC transformer
b. DC rectifier
c. AC-DC transformer-rectifier with high frequency
d. all of the above

W97. The three types of electrodes used for gas tungsten arc welding are thoriated, zirconiated tungsten, and:

a. pure tungsten
b. zinc tungsten
c. zinc
d. tungsten carbonate

W98. Where is the filler wire applied to the puddle?

a. center
b. back edge
c. leading edge
d. none of the above

W99. What is never produced during TIG welding?

a. slag
b. stinger
c. fumes
d. flux

W100. The inert gases used most often during TIG welding are:

a. hydrogen and ethylene dioxide
b. carbon dioxide and nitrogen
c. argon and helium
d. oxygen and acetylene

W101. Before starting a weld, all joints should be cleaned with a/an:

a. stainless steel wire brush
b. soap and water rinse
c. copper wire brush
d. oiled cloth

W102. To eliminate contamination in a weld, the welder should strike the arc on a:

a. backing strip
b. starting block
c. piece of flint
d. piece of scrap steel

W103. An unstable arc is usually due to:

a. welding too fast
b. a water leak
c. a contaminated or dirty electrode
d. too much amperage

W104. What function does tungsten perform in TIG welding?

a. conducts the weld current to the work
b. forms the bead
c. cleans the metal
d. all of the above.

W105. What are the two methods of metal transfer used by the MIG process?

a. spray arc and short arc
b. fusion and cohesion
c. alpha and beta
d. argon and carbon

W106. What are whiskers?

a. short lengths of wire that have not melted in the weld
b. slag in the weld
c. small balls of metal on the weld base
d. bubbles of air caught in the weld

W107. What shielding gas is generally used in AC TIG welding?

a. oxygen
b. helium
c. argon
d. hydrogen

W108. What inert-gas is used in the short-arc welding of most steel?

a. hydrogen
b. carbon dioxide or a mixture of 75% argon and 25% carbon
c. oxygen
d. none of the above

W109. What type of compound can be applied to nozzle and contact tips to make cleaning easier?

a. anti-spatter
b. gases
c. flux
d. all of the above

W110. The cables for MIG welding are usually made of:

a. copper
b. stainless steel
c. aluminum
d. bronze

W111. Unlike TIG welding, the electrodes used for MIG welding are:

a. consumable
b. nonconsumable
c. longer than 36 inches
d. flux coated

W112. What kind of motion can be used to control the weld puddle?

a. dragging
b. whipping
c. back-and-forth
d. all of the above

W113. Microwire diameters range from:

a. 0.030 inch to 0.045 inch
b. 1/4 inch to 3/8 inch
c. 1/8 inch to 5/8 inch
d. 0.40 inch to 0.100 inch

W114. Larger grooves can be filled more efficiently by:

a. GTAW than MIG
b. MIG than TIG
c. TIG than MIG
d. SMAW than TIG

W115. When welding aluminum, the gun is always pointed in the direction of travel to help keep____________out of the weld.

a. heat
b. spatter
c. contamination
d. soot

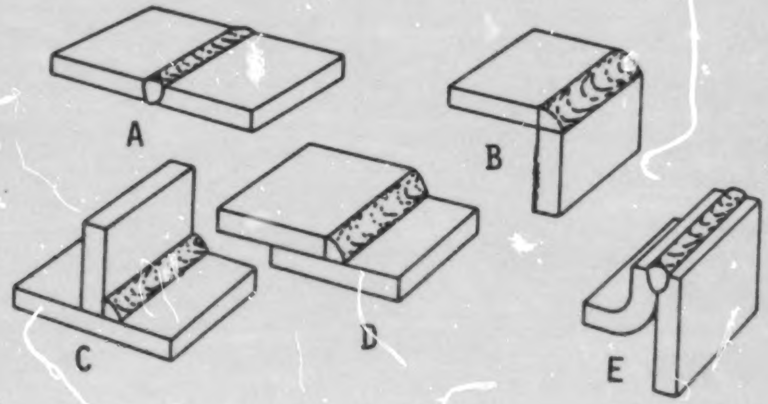
W116. When the arc forms properly but does not penetrate, the condition is called a:

a. hot start
b. low start
c. cold start
d. normal start

W117. Upon completion of the last pass, metal should be cooled with:

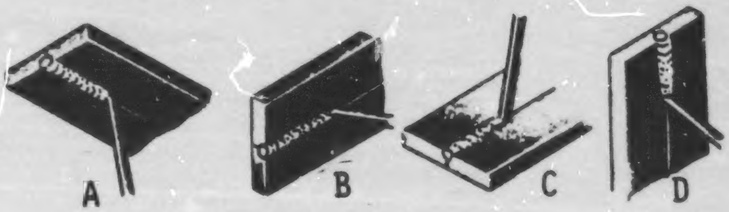
a. cold air
b. still air
c. an air blower
d. hot air

W118. Identify the five basic welding joints shown below by placing the letter beside each picture in the blank next to the correct name:



_______ 1. outside corner
_______ 2. edge
_______ 3. inside corner or T
_______ 4. butt
_______ 5. lap

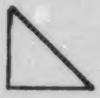
W119. Identify the four basic welding positions shown below by placing the letter beside each picture in the blank next to the correct name:



_______ 1. overhead position
_______ 2. vertical position
_______ 3. flat position
_______ 4. horizontal position

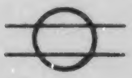
W120. The name for the weld symbol shown below is:

a. plug
b. fillet
c. seam
d. surfacing



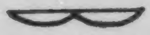
W121. The name for the welding symbol shown below is:

a. fillet
b. edge
c. spot
d. seam



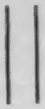
W122. The name for the welding symbol shown below is:

a. seam
b. surfacing
c. spot
d. plug



W123. The name for the welding symbol shown below is:

a. seam
b. fillet
c. square
d. projetion



W124 **Task** Set up oxyacetylene Equipment

Tools and Materials

1. Acetylene cylinder
2. Acetylene hoses
3. Acetylene regulator
4. Combination tank wrench
5. Key wrench
6. O_2 cylinder
7. O_2 hoses
8. O_2 regulator
9. Torch assembly

Conditions	Student must be provided with a complete oxyacetylene set-up. Instructions must be provided noting how the equipment should be set-up when the task is finished.
Specifications	Cylinders must be secured, vented and leak free. Regulators must be attached to cylinders with O_2 fully open and acetylene 1/4-1/2 turn. Hoses should be attached to respective fitting and be free of leaks.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Secure cylinders in position		
2. Open and close valves quickly to vent obstructions or foreign material		
3. Attach regulators		
4. Back off regulator adjusting screws		
5. Attach respective hoses to regulators		
6. Attach torch assembly to hoses		

W124 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
7. Open acetylene valve 1/4-1/2 turn		
8. Open oxygen valve fully		
9. Set adjust screws to desired pressure		
10. Check for leaks with soapy water		

Was correct procedure followed when performing the stated task?

______Yes ______No

Were performance specifications and/or criteria stated in the task met? ______Yes ______No

W125 **Task** Cut metal

Tools and Materials

1. Striker
2. Oxyacetylene cutting equipment
3. Protective clothing/equipment
4. Cutting tip assortment
5. Welders standard tool kit
6. Work order
7. Workpiece showing cut lines

Conditions	Furnish student with workpiece(s) with premarked cut lines. Instructions should be given to cut the metal to specified tolerances.
Specifications	Material should be cut sharp and clean with light, vertical drag lines to drawing or specified conditions.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Install cutting tip		
2. Check/clean tip as necessary		
3. Adjust pressures for cutting		
4. Ignite torch and adjust		
5. Depress oxygen valve and readjust flame		
6. Preheat metal to cutting temperature		
7. Cut metal to specifications		
8. Shut off tanks		

W125 (continued)

Was correct procedure followed when performing the stated task?

_______Yes _______No

Were performance specifications and/or criteria stated in the task met? _______Yes _______No

W126 **Task** Pierce and cut a hole to specified diameter with oxyactylene equipment

Tools and Materials

1. Striker
2. Oxyacetylene cutting equipment
3. Protective clothing equipment
4. Cutting tips
5. Welders' standard tool kit
6. Work order
7. Workpiece showing cut lines

Conditions Furnish student with workpiece(s) with premarked cut lines. Instructions should be given to pierce and cut a hole to specified tolerances.

Specifications Material should be pierced and hole cut to specifications. Drag lines must be verticle and not pronounced.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Make sure area is hazard free		
2. Install cutting tip		
3. Check/clean tip as necessary		
4. Adjust pressure for cutting		
5. Ignite torch and adjust		
6. Adjust pre-heating flame		
7. Depress oxygen valve and readjust flame		
8. Preheat metal to cutting temperature		
9. Pierce and cut metal		
10. Shut off tanks		

W126 (continued)

Was correct procedure followed when performing the stated task?

_______Yes _______No

Were performance specifications and/or criteria stated in the task met? _______Yes _______No

W127 **Task** Make an outside corner joint weld without a rod

Tools and Materials

1. Striker
2. Oxyacetylene welding equipment
3. Welding tips
4. Protective clothing
5. Welders' standard tool kit
6. Wire brush
7. Workpieces
8. Combination square

Conditions Furnish student with pre-cut workpieces of same thickness. Provide instructions for welding the pieces including specifications.

Specifications Joint should display the characteristics of a good weld, and the angle must be 90° ± 2°.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Checked work area for hazards		
2. Selected/installed welding tip		
3. Put on protective clothing		
4. Adjusted gas pressure		
5. Ignited torch and adjusted flame		
6. Readjusted regulators		
7. Aligned 2 workpieces on long ends to form a 90° corner		
8. Tacked metal on each end		
9. Welded joint without filler rod		

W127 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
10. Checked weld for penetration and strength		
11. Shut tanks down		

Was correct procedure followed when performing the stated task?

______Yes ______No

Were performance specificaitons and/or criteria stated in the task met? ______Yes ______No

W128 **Task** Layout and make circular cuts with oxyacetylene equipment

Tools and Materials

1. Striker
2. Oxyacetylene cutting equipment
3. Protective clothing equipment
4. Cutting tips
5. Welders' standard tool kit
6. Work order
7. Workpiece showing cut lines

Conditions	Furnish student with workpiece(s). Instructions should be given to layout radius lines and cut to specifications.
Specifications	Materials should be marked for circular cuts. Material should be cut sharp and clean with unpronounced verticle drag lines.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Obtained tools and materials		
2. Located the center of a plate		
3. Center punched plate		
4. Attached circle cutting attachment to torch		
5. Set attachment to specified radius		
6. Lit torch and adjusted flame		
7. Preheated edge of material		
8. Cut the circle from the plate		
9. Shut off tanks		

W128 (continued)

Was correct procedure followed when performing the stated task?

______Yes ______No

Were performance specifications and/or criteria stated in the task met? ______Yes ______No

W129 **Task** Make a lap joint

Tools and Materials

1. Striker
2. Oxyacetylene welding equipment
3. Oxyacetylene welding tips
4. Welders' standard tool kit
5. Welding rods
6. Wire brush
7. Workpiece(s)

Conditions Student should be furnished with gas welding equipment, welders' standard tool kit and protective clothing. Instructions should be given to make a lap joint with filler rod.

Specifications The joint must display the characteristics of a good weld and the deposit of filler rod must be uniform.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Selected and installed welding tip		
2. Cleaned tip if necessary		
3. Adjusted gas pressure for welding		
4. Put on protective attire		
5. Ignited torch		
6. Adjusted flame		
7. Positioned workpieces with 1 1/2 inch overlap		
8. Tacked workpiece at ends, middle and opposite sides		

W129 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
9. Used filler rod and welded joint		
10. Turned workpiece over and welded other joint		
11. Tested weld		
12. Bled lines		

Was correct procedure used to make the lap joint?

_______Yes _______No

Did the joint display the characteristics of a good weld with a uniform deposit of filler rod metal? _______Yes _______No

W130 **Task** Make braze welding beads

Tools and Materials

1. Striker
2. Oxyacetylene welding equipment
3. Oxyacetylene welding tips
4. Protective attire
5. Welders' standard tool kit
6. Bronze rods
7. Wire brush
8. Workpiece(s)

Conditions Student should be furnished with gas welding equipment, welders' standard tool kit, and protective clothing. Instructions should be given to braze weld beads with a flux coated filler rod.

Specifications The weld must display the characteristics of a good weld with a uniform deposit of filler rod metal.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Selected and installed welding tip		
2. Cleaned tip if necessary		
3. Adjusted gas pressure for brazing		
4. Put on protective attire		
5. Ignited torch		
6. Adjusted flame for brazing		
7. Cleaned metal thoroughly with wire brush		
8. Heated surface to be welded		

W130 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
9. Concentrated flame on starting end of metal until it turned a dull red		
10. Laid out lines 1 inch apart on the workpiece		
11. Welded a braze bead along each line		
12. Bled lines		

Was correct procedure used to braze weld beads?

______Yes ______No

Did the weld display the characteristics of a good weld with a uniform deposit of filler rod? ______Yes ______No

W131 **Task** Make a lap joint

Tools and Materials

1. Portable screens
2. Protective clothing/equipment
3. Welders' standard tool kit
4. Wire brush
5. Arc welder
6. Workpiece

Conditions Student should be given arc welding equipment, welders' standard tool kit, and protective clothing/equipment. Instructions should be given to weld a lap joint in the horizontal position.

Specifications Each pass must be deposited with complete fusion and must be free from slag inclusions and slag porosity. The head must be smooth and the welds executed without undercutting, burn-thru, or cracking.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Put on protective attire		
2. Checked to be sure hood had required lens for welding process		
3. Turned on set, and adjusted welding machine		
4. Ran a test on a piece of scrap metal		
5. Adjusted polarity and current		
6. Fastened one end of the plates to a support clamp and the other piece on top of it		

W131 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
7. Tac welded the two pieces together		
8. Welded the lap joint with a single pass weave pattern		

Was correct procedure followed to make the lap joint?

______Yes ______No

Was each pass deposited with complete fusion with no slag inclusions or slag? ______Yes ______No

Was the head smooth? ______Yes ______No

Were the welds executed without undercutting, burn-thru, or cracking?

______Yes ______No

W132 **Task** Run beads

Tools and Materials

1. Protective clothing/equipment
2. Repair/maintenance kit
3. TIG welding equipment
4. Wire brush
5. 1/4 inch aluminum workpiece
6. Welders' standard tool kit
7. Filler metal

Conditions

Student should be furnished with TIG welding equipment, welders' standard tool kit, and protective clothing/equipment. Instructions should be given to run beads in the flat position.

Specifications

Each pass must be deposited with complete fusion and be free from slag and porosity. The beads must be smooth.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Put on protective attire		
2. Checked position of workpiece		
3. Turned on welding machine		
4. Readjusted gas flow rate, voltage, current, and water flow		
5. Marked off parallel lines on workpiece		
6. Set machine for 1/4 inch aluminum		

W132 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
7. Made two passes on each side of the line		
8. Made a third pass on top of the two previous passes		

Was correct procedure followed as beads were run?

______Yes ______No

Was each pass deposited with complete fusion, and no slag or porosity?

______Yes ______NO

Were the beads smooth? ______Yes ______NO

W133 **Task** Make a T-joint

Tools and Materials

1. Arc welder
2. Portable screens
3. Protective clothing/equipment
4. Welders' standard tool kit
5. Wire brush
6. Workpiece(s)

Conditions Student should be furnished with arc welding equipment, welders' standard tool kit and protective clothing/equipment. Instructions should be given to make a square T-joint in the overhead position.

Specifications Each pass must be smooth with no undercutting, burn-thru, or cracking. The underside of the root pass must make full penetration.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Put on protective attire		
2. Checked to be sure hood had required lens for welding process		
3. Turned on welding machine		
4. Ran test bead on piece of scrap metal		
5. Adjusted polarity and amps		
6. Tacked two pieces together to form a T and positioned them in the overhead manner		

W133 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
7. Made one pass in the root of the joint		
8. Checked for penetration		
9. Made second and third passes		
10. Turned piece over and repeated process		

Was correct procedure followed in making the T-joint?

______Yes ______No

Was each pass smooth with no undercutting, burn-thru, or cracking?

______Yes ______No

Did the underside of the root pass make full penetration?

______Yes ______No

W134 **Task** Make an outside corner joint without a rod

Tools and Materials

1. Striker
2. Oxyacetylene welding equipment
3. Oxyacetylene welding tips
4. Protective clothing
5. Welders' standard tool kit
6. Wire brush
7. Workpiece(s)
8. Combination square

Conditions Student should be given gas welding equipment, welders' standard tool kit, and protective clothing/equipment. Instructions should be given to make an outside corner joint weld without a rod.

Specifications The joint must display the characteristics of a good weld and the angle must be 90° ± 2°

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Selected and installed welding tip		
2. Cleaned tip if necessary		
3. Adjusted gas pressure for welding		
4. Put on protective clothing		
5. Ignited torch		
6. Adjusted flame		
7. Readjusted regulators as needed		
8. Aligned two pieces on long ends to form a 90° corner		

W134 (continued)

Procedure	Acceptable Behavior Observed	Accepteble Behavior Not Observed
9. Tacked metal on each end		
10. Welded joint without filler rod		
11. Checked weld for penetration		
12. Shut tanks down and backed out adjusting screws		

Was correct procedure used to make the corner joint?

_______Yes _______No

Did the joint display the characteristics of a good weld with the angle 90° ± 2°? _______Yes _______No

W135 **Task** Make a fillet weld

Tools and Materials

1. MIG welding equipment
2. Protective clothing/equipment
3. Weld gauge
4. Wire brush
5. Workpiece(s)
6. Welders' standard tool kit

Conditions Student should be furnished with MIG welding equipment, welders' standard tool kit and protective clothing/equipment. Instructions should be given to make a fillet weld.

Specifications The weld must be deposited with complete fusion and must be free from overlapping, cracking, and porosity. It must be at least 25% greater in width than depth.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Put on protective attire		
2. Checked to be sure eye protection equipment had required lens for welding process		
3. Checked position of workpiece		
4. Turned on welding machine		
5. Ran test bead on piece of scrap metal		
6. Readjusted inert gas flow rate, voltage, current, wire-feed speed, and inductance		
7. Ran fillet weld		
8. Cleaned with wire brush		

W135 (continued)

Was correct procedure followed in making the fillet weld?

______Yes ______No

Was weld deposited with complete fusion with no overlapping, cracking, and porosity? ______Yes ______No

Was the weld at least 25% greater in width than depth?

______Yes ______No

W136 (continued)

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
7. Fastened plate in overhead position		
8. Supported cable over shoulder or knee and gripped holder in proper manner		
9. Struck an arc and ran bead		
10. Wire brushed the bead		
11. Checked penetration and nipple pattern		
12. Ran beads along remaining lines		
13. Turned workpiece over and repeated operation		

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Was correct procedure followed as beads were run?

______Yes ______No

Was each pass deposited with complete fusion and no slag inclusions, porosity, and undercutting? ______Yes ______No

Were beads smooth? ______Yes ______No

W136 **Task** Run beads

Tools and Materials

1. Portable screens
2. Protective clothing/equipment
3. Welders' standard tool kit
4. Wire brush
5. Arc welder
6. Metal plates

Conditions Student should be furnished with arc welding equipment, welders' standard tool kit, and protective clothing/equipment. Instructions should be given to run beads in the overhead position.

Specifications Each pass must be deposited with complete fusion and be free from slag inclusions, porosity, and undercutting. The beads must be smooth.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Put on protective attire		
2. Checked to be sure hood had required lens for welding process		
3. Turned on welding machine		
4. Ran test bead on piece of scrap metal		
5. Adjusted polarity and amps		
6. Drew a series of lines parallel to the long side of the workpiece 1/2 inch apart		

W137 Task Make a T-joint

Tools and Materials

1. Arc welder
2. Portable screens
3. Protective clothing/equipment
4. Welders' standard tool kit
5. Wire brush
6. Metal plates

Conditions	Student should be given arc welding equipment, welders' standard tool kit, and protective clothing/equipment. Instructions should be given to weld a square T-joint in the vertical position.
Specifications	Each pass must be deposited with complete fusion without slag inclusions, or porosity. The beads must be smooth and executed without undercutting, burn-thru, or cracking. The underside of the root pass must make full penetration.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Put on protective attire		
2. Check to be sure hood has required lens for welding process		
3. Turned on welding machine		
4. Ran test bead on piece of scrap metal		
5. Readjusted voltage, current, and inductance as required		
6. Positioned the two pieces together to form a T-joint and made a tack weld		

W137 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
7. Used an upward stroke and made one pass		
8. Chipped and wire brushed the bead		
9. Checked for penetration		
10. Made a second pass and used a wide weave pattern		

Was correct procedure used to make the T-joint?

______Yes ______No

Was each pass deposited with complete fusion with no slag inclusions or porosity? ______Yes ______No

Were the beads smooth and executed without undercutting, burn-thru, or cracking? ______Yes ______No

Did the underside of the root pass make full penetration?

______Yes ______No

MACHINE SHOP

M1. One-thousandth of an inch in decimal form is:

a. 0.1 inch
b. 0.01 inch
c. 0.001 inch
d. 0.0001 inch

M2. The outside micrometer caliper is made of several parts that are all held by:

a. an anvil
b. a lock
c. a barrel
d. a frame

M3. The special scale on the sleeve of micrometers which increases the accuracy of measurements ten fold is called a:

a. metric scale
b. decimal scale
c. fractional scale
d. vernier scale

M4. What part of the micrometer controls the amount of pressure on the spindle when making measurements?

a. ratchet
b. thimble
c. lock nut
d. anvil

M5. How many graduations are found on metric micrometer thimbles?

a. 10
b. 25
c. 50
d. 100

M6. A standard micrometer has a discrimination of what part of an inch?

a. .001
b. .010
c. .011
d. .0001

M7. Gauge blocks used to check or set an angle to minutes of accuracy are called:

a. height gauges
b. indicator bars
c. sine bars
d. surface gauges

M8. Which of the following instruments is often used with gauge blocks to establish precise angles?

a. optical collinator
b. abney level
c. sine bar
d. vernier bevel protractor

M9. When layout lines must be accurate to within .001 inch, a machinist should use the:

a. surface gauge method
b. vernier height gauge method
c. combination set method
d. trammel point method

M10. The tool used to layout a parallel line to a shoulder or edge of a workpiece is called a:

a. compass
b. divider
c. hermaphrodite caliper
d. scribe

M11. When using a combination set for laying out a 45° angle, the blade should be mounted on the:

a. square head
b. protractor head
c. center head
d. depth gauge attachment

M12. When scribing perpendicular lines, the workpiece must be:

a. inverted
b. turned 90 degrees
c. left as is and the height gauge used on an angle plate
d. set on a parallel bar

M13. Angle plates are used in layout work for:

a. holding the work parallel
b. holding the layout tool
c. holding the work for prick punching
d. supporting the surface plate

M14. Why are layout lines prick punched after they are scribed?

a. to make the layout lines more visible
b. to determine the starting point of the layout
c. to determine the finishing point of the layout
d. to prevent destroying the layout line

M15. Which of the following tool is used for cleaning files?

a. brush card
b. bench brush
c. file card
d. emery cloth

M16. Which of the following is not part of a file?

a. tip
b. heel
c. face
d. tang

M17. Which of the following files would be used to smooth file a piece of flat stock?

a. single-cut file
b. double-cut file
c. rasp file
d. vixen file

M18. A file is made of:

a. mild steel
b. alloy steel
c. tungsten
d. high-carbon steel

M19. Draw filing is performed to:

a. remove stock quickly
b. produce a smooth finish
c. use the full length of the file
d. remove burrs

M20. What can be applied to the face of a file to prevent chips from clogging the teeth?

a. chalk
b. oil
c. water
d. powder

M21. The width of the cut made by a saw blade is called the:

a. clearance
b. allowance
c. kerf
d. gauge

M22. What is the best position for your feet when using the hacksaw?

a. feet together
b. feet far apart
c. feet apart and pointing toward the work
d. feet apart and pointing at a 90° angle to the work

M23. What is the recommended cutting speed for the hand hacksaw?

a. 40 strokes per minute
b. 60 strokes per minute
c. 80 strokes per minute
d. 90 strokes per minute

M24. The blade of a hand hacksaw makes a cut wider than the blade because:

a. the blade locks sideways
b. the teeth have kerf
c. the teeth have set
d. all of the above

M25. The number of teeth per inch on a blade is called the:

a. clearance angle
b. off set
c. pitch
d. tooth

M26. Which of the following taps is used to thread an open or through hole?

a. tapered tap
b. plug tap
c. bottom tap
d. pointed tap

M27. The tap drill must be slightly larger than which of the following thread diameters?

a. major
b. minor
c. mean
d. exterior

M28. A small tap is held with a:

a. straight handle wrench
b. T-handled wrench
c. small wrench
d. adjustable wrench

M29. Which of the following tools is used to determine whether a tap is started straight?

a. plumb
b. square
c. divider
d. sliding T-bevel

M30. The size of a tap is stamped on the:

a. end
b. top
c. flute
d. shank

M31. Which of the following taps is used to thread a blind hole?

a. plug tap
b. pointed tap
c. tapered tap
d. bottom tap

M32. A die is "backed off" in order to:

a. give the die a running start at the metal to be removed
b. straighten the thread
c. break the chip
d. allow the cutting oil to run ahead of the die

M33. Which of the following tools is used to determine if a die is straight?

a. machinists square
b. spitit level
c. protractor
d. plumb bob

M34. A round split die is expanded and contracted by a:

a. tapered wedge
b. nut
c. screw
d. carriage bolt

M35. The handle used on a hand die is called a:

a. crescent wrench
b. tap wrench
c. die stock
d. die plate

M36. The margin of the drill is:

a. two or more helical grooves, cut around the body of the drill
b. the undercut portion of the body
c. the narrow, raised section on the body of the drill next to the flutes extending the length of the flutes
d. the thin partition in the center of the drill extending the full length of the flutes

M37. The size of a drill press is determined by the:

a. largest size drill that will fit the machine
b. highest velocity the drill will rotate
c. distance from the edge of the column to the center of the spindle
d. weight of the machine

M38. The quill spindle is a round shaft which holds the:

a. chuck
b. table
c. motor
d. head

M39. The feed handle of a drill press:

a. has 6 speeds
b. controls the up and down movement
c. holds tools up to 13 mm in diameter
d. can be set to spin around the column

M40. The drill chuck of a drill press:

a. is used to drill holes through the table
b. holds drill bits and other tools
c. has a capacity from 1/2 inch to 13 mm
d. fits into 3 holes in the body

M41. A drift is the:

a. amount the drill shifts from the centered hole
b. tool used to remove the drill from the spindle
c. amount of taper from one end of a hole to the other end
d. sleeve into which a drill fits

M42. The most commonly used drill is the:

a. twist drill
b. core drill
c. straight fluted drill
d. high helix drill

M43. When making a punch mark for the drill to pick up, it is best to use a:

a. prick punch
b. center punch
c. chisel punch
d. scratch awl

M44. If the operating speed of a drill is too fast, it will cause:

a. the web to split
b. the drill to penetrate the work very slowly
c. the outer corners of the drill to wear away quickly
d. the drill to gall

M45. To drill a 1/2 inch hole in a piece of machine steel at a speed of 80 F.P.M., at what RPM should the drill press be operated?

a. 610-640 RPM
b. 755-800 RPM
c. 428-450 RPM
d. 1000-1050 RPM

M46. A countersink is used for:

a. making seats for flat head scews
b. drilling holes in counters
c. enlarging a hole to recess a bolt head
d. none of the above

M47. The name of the operation that makes holes larger and to an exact size is:

a. drilling
b. reaming
c. boring
d. sizing

M48. A counterbore is used for:

a. making seats for flat head screws
b. enlarging holes to recess a bolt head
c. boring holes in counters
d. none of the above

M49. Which of the following tools is used to resurface the face of the grinding wheel?

a. wheel conditioner
b. wheel dresser
c. wheel resurfacer
d. wheel smoother

M50. Flat work for surface grinding is usually held by a:

a. four-jaw chuck
b. face plate
c. magnetic chuck
d. three-jaw chuck

M51. The table stops on a surface grinder should always be set to give:

a. 1-1/2 inches override on each end of the workpiece
b. 1 inch override on each end of the workpiece
c. 1/2 inch override on each end of the workpiece
d. 2 inches override on each end of the workpiece

M52. The depth of a finishing cut for a small surface grinder should be:

a. .010 to .015 inch
b. .001 to .002 inch
c. .003 to .005 inch
d. .005 to .010 inch

M53. What control on the lathe is used to fix the screw pitch?

a. half nut lever
b. feed change lever
c. tumbler levers
d. feed reverse levers

M54. The wheel of a surface grinder should be dressed and trued with a:

a. diamond wheel dresser
b. wheel dresser
c. cutting tool
d. stone

M55. Vibration while using the surface grinder may be caused by:

a. the wheel vibrator
b. a wheel that is too soft
c. an unbalanced wheel
d. dirty coolant

M56. The tool rest on the grinder should be set so that it is in line with:

a. the horizontal axis
b. the vertical axis
c. the center of the grinding wheel
d. the center of the workpiece

M57. A cutting tool should be cooled as it is ground in order to prevent:

a. damaging the wheel
b. burning the operator
c. melting the metal
d. drawing the temper

M58. Pedestal grinders with aluminum-oxide wheels should not be used to grind:

a. drills
b. iron or steel
c. aluminum or brass
d. punches and chisels

M59. What should be used to clean the lathe?

a. soap and water
b. paint remover
c. kerosene
d. air pressure

M60. The tool post on a lathe is directly connected to the:

a. compound rest
b. cross slide
c. carriage
d. ways

M61. The carriage of the lathe rides on the:

a. headstock
b. tailstock
c. ways
d. column

M62. Chips on the lathe should be removed with a:

a. brush
b. rag
c. cloth rag
d. sponge

M63. The independent chuck has:

a. four jaws that move at the same time
b. four jaws that move independently
c. a special adjusting system
d. three jaws that move independently

M64. The most accurate method of securing the work in an independent chuck is to use:

a. concentric circles
b. the point of the cutting tool
c. a piece of chalk
d. a dial indicator

M65. The lathe term "feed rate" indicates the rate at which the:

a. spindle turns
b. tailstock moves
c. carriage moves
d. headstock moves

M66. When center drilling on the lathe, the drill can be mounted in the headstock or in the:

a. tailstock
b. tool post holder
c. boring bar
d. center rest

M67. The best method of locating the center of a round piece of work is with the:

a. inside calipers
b. outside calipers
c. screw pitch gauge
d. center head

M68. Work to be turned between centers requires that the ends be drilled with suitable holes for a:

a. cutting tool
b. lathe center
c. tailstock
d. compound rest

M69. Which lathe tool drives or turns the workpiece when machining between centers?

a. dog
b. chuck
c. line center
d. mandrel

M70. Counterboring involves boring and:

a. countersinking
b. turning outside shoulders
c. facing internal shoulders
d. spot facing

M71. Drills smaller than 1/2 inch are:

a. not used on the lathe
b. held in a jacob's chuck
c. held in the tailstock spindle
d. held in a drill holder

M72. Which of the following lathe operations is performed in order to provide a tapered hole for a flat head screw?

a. center drill
b. counterbore
c. countersink
d. ream

M73. What kind of operation is knurling?

a. forming
b. cutting
c. shaping
d. slotting

M74. Knurling on metal handles provides:

a. better grip
b. a longer lasting part
c a better part
d. no significant improvement

M75. Which part of the lathe has knurled parts?

a. quick change gear box
b. leadscrew
c. micrometer collar
d. apron

M76. Knurls make a pattern on the workpiece by:

a. cutting the material
b. displacing the material
c. compressing the material
d. removing the material

M77. Which of the following controls is used with a thread dial indicator?

a. half nut lever
b. feed change lever
c. clutch knob
d. feed reverse lever

M78. When threading on a lathe, the compound rest is set at:

a. 19°
b. 39°
c. 29°
d. 27°

M79. Why must a thread chasing dial be used when cutting threads?

a. to regulate the lathe speed
b. to determine the number of threads
c. to give the right thread angle
d. to determine when to close the half nut for a repeat cut

M80. The half nut lever on a lathe is used for:

a. engaging the longitudinal feed on the carriage
b. taking up the slack in the cross slide nut
c. changing from longitudinal to cross feed
d. threading

M81. The standard V thread is:

a. 30°
b. 45°
c. 60°
d. 75°

M82. Threads are cut or chased on a lathe with a single point tool by:

- a. taking a series of cuts in the same groove
- b. taking only trial cuts
- c. using a thread die
- d. using a taper attachment

M83. When threading on a lathe, the tool bit is aligned with the workpiece using a:

- a. center gauge
- b. screw pitch gauge
- c. thread gauge
- d. tool blank

M84. Matching tapers can be turned and bored readily by swiveling the:

- a. compound
- b. tool holder
- c. guide bar
- d. tailstock

M85. Which method of taper turning is best suited for machining a 60° lathe center point?

- a. tailstock set over
- b. compound rest
- c. taper attachment
- d. carriage set over

M86. When using the taper attachment, the power feed should be engaged at least 1 inch before the start of the cut in order to:

- a. allow for expansion of the workpiece
- b. remove any play in the taper attachment
- c. get a smooth start
- d. all of the above

M87. When turning a taper on the lathe, it is important to set the cutting tool:

- a. slightly above center
- b. slightly below center
- c. on center
- d. at a right angle to center

M88. The purpose of the edge finder on the milling machine is to:

a. help maintain squareness of the workpiece
b. locate holes
c. mill sides of a workpiece
d. allow the operator to locate the exact position for the machining operation

M89. The best way to remove excess chips from the milling machine is with:

a. an air hose
b. a brush
c. rags
d. with the hands

M90. The recommended cleaning fluid for cleaning a milling machine is:

a. gasoline
b. diesel fuel
c. mineral spirits
d. carbon tetrachloride

M91. The knee on the vertical milling machine can be moved up and down by:

a. power feed
b. rapid traverse
c. turning the elevating crank handle
d. turning the cross feed handle

M92. The most common work holding device for the milling machine is:

a. clamps
b. dividing head
c. vise
d. T-bolts

M93. Which of the following is used to insure proper alignment of the milling head?

a. square
b. dial indicator
c. Go or No Go gauge
d. micrometer

M94. Mill heads are graduated in:

a. inches
b. feet
c. millimeters
d. degrees

M95. Proper alignment of the vertical head is important because:

a. the workpiece may be out of round
b. drilled holes could be oversize
c. it insures flatness, squareness, and perpendicularity
d. it allows greater tolerance

M96. The depth of any standard keyseat is always:

a. twice the cutter width
b. 1/2 the cutter width
c. 1/3 the cutter width
d. 1/4 the cutter width

M97. The size of a keyway is determined by the:

a. diameter of the shaft
b. length of the shaft
c. diameter of the cutter
d. all of the above

M98. The most precise way to locate a cutter centrally over a shaft is:

a. with a spirit level
b. by trial and error
c. position with the cross feed dial when the cutter touches the work
d. determine the radius of the shaft

M99. The size of a shaper is determined by the:

a. length of the stroke of the ram
b. largest cube of metal that can be machined
c. amount of horizontal movement of the table
d. amount of vertical movement of the table

M100. What factors affect the cutting speed used on a shaper?

a. tool material
b. work material
c. kind of cut made
d. all of the above

M101. The total permissable variation of a part dimension is referred to as the:

a. allowance
b. tolerance
c. allowance plus tolerance
d. clearance

M102. The standard of metric linear measurement is the:

a. meter
b. decimeter
c. centimeter
d. millimeter

M103. The smallest graduations on a 6 inch pocket rule is usually:

a. 1/16 inch
b. 1/32 inch
c. 1/64 inch
d. 1/10 inch

M104. How is accuracy checked along the range of travel on the depth micrometer?

a. measuring over gauge blocks
b. measuring the same depth with another depth micrometer
c. taking measurements at the highest and lowest point
d. placing the base on a surface plate and taking a reading

M105. On what surface would chalk be used to coat the surface for layout?

a. machined steel
b. machined aluminum
c. machined cast iron
d. rough surfaces of a casting

M106. A file with a three-sided shape is called a:

a. triangle file
b. three-surface file
c. rasp-cut file
d. vixen-cut file

M107. The teeth on the blade of a hand hacksaw must point:

a. toward the handle
b. toward the front of the saw
c. up
d. down

M108. What can be done to prevent "chatter" for the stock and blade when using the hand hacksaw?

a. clamp the stock on edge in a vise
b. clamp the cut near the vise jaws
c. hold the center end with your hand
d. all of the above

M109. The formula used to calculate R.P.M. for the drill press is:

a. $\frac{CS \times 4}{D}$

b. $\frac{CS \times 4}{L}$

c. $\frac{D \times 4}{CS}$

d. $\frac{L \times D}{CS}$

M110. What is the cutting speed when machine steel is drilled using a high speed drill bit?

a. 300 FPM
b. 200 FPM
c. 80 FPM
d. 60 FPM

M111. The included angle of a countersink for American Standard machine screws is:

a. 100 degrees
b. 90 degrees
c. 82 degrees
d. 60 degrees

M112. A hole is countersunk in order to:

a. enlarge the hole to a specified depth
b. produce a flat surface around the hole
c. produce an angle at the hole opening
d. drill a blind hole

M113. The grade of a grinding wheel is defined by:

a. numbers 1 to 5
b. letters a to z
c. fine, medium, and coarse
d. two numbers and a letter

M114. Grinding on a pedestal grinder is called:

a. circular grinding
b. rough grinding
c. off hand grinding
d. free grinding

M115. Which of the following substances is used to lubricate the lathe?

a. case water
b. grease
c. lubricating oil
d. kerosene

M116. Which of the following conditions is an advantage of turning between centers?

a. less chatter is produced
b. more positive drive is possible
c. a shaft can be turned end for end without loss of concentricity
d. long work can be supported in a steady rest

M117. Which of the following operations results in a slow lathe speed?

a. disengage the back gear
b. lock in the bull gear
c. release the bull gear pin
d. tighten down on the knockout gear

M118. What happens if the drill speed is too slow for the diameter of the drill and the material being drilled?

a. the margins and outer corners are broken down
b. more feed is required to get the drill to cut
c. chips jam in the flutes
d. the cutting edges become dulled

M119. What happens if the drill speed is too fast for the diameter of the drill and the material?

a. a rough hole is produced
b. chips jam in the flutes
c. the margins or outer corners are broken down
d. more feed is required to get the drill to cut

M120. Which of the following formulas is used to find R.P.M. for drilling on the lathe?

a. $\frac{750}{N}$

b. $\frac{\text{CS X 7}}{\text{LS}}$

c. $\text{CS} = \text{NS X LS X .14}$

d. $\frac{\text{CS X 4}}{\text{Diameter}}$

M121. Which of the following cutting fluids would be best for drilling low carbon steel?

a. lubrication oil
b. soluble oil
c. sulfurized oil
d. kerosene

M122. In order to cut a unified right hand "V" thread the compound rest must be set on:

a. 14.5 degrees
b. 60 degrees
c. 29 degrees
d. 30 degrees

M123. The screw pitch gauge is used to check the:

a. angle of threads
b. depth of threads
c. number of threads per inch
d. tool bit angle

M124. Which of the following methods of turning tapers cannot be used for boring tapers?

a. tailstock set over
b. compound rest
c. taper attachment
d. carriage set over

M125. The taper attachment guide bar is graduated in taper per foot at one end and:

a. taper per inch at the other
b. taper per yard at the other
c. degrees at the other
d. angles at the other

M126. The best location for a milling machine vise is:

a. the center of the bed
b. off center, the width of the jaws
c. the extreme right side of the bed
d. the extreme left side of the bed

M127. Before placing the vise on the bed of the milling machine always:

a. coat the bed with oil
b. clean and remove burrs with an emory cloth
c. remove the vise jaws
d. remove base keys from vise

M128. The cutting speed when milling a keyway depends upon:

a. the diameter of the shaft and material cut
b. the diameter of the shaft and depth of cut
c. the diameter of the cutter and material cut
d. all of the above

M129. Which of the following markings indicates the proper position of holes to be drilled in metal?

a. prick punch marks
b. center punch marks
c. crossed line marks
d. curved line marks

M130. How can the fraction 14/32 be stated in its lowest terms?

a. 7/16
b. 7/8
c. 7/4
d. 3/4

M131. The diameter of a circle with a radius of 3/8 inch is:

a. 1/2 inch
b. 3/4 inch
c. 2/3 inch
d. 1/4 inch

M132. Twenty feet of stock is required to make 50 cap screws. How much stock is required to make 20 cap screws?

a. 10 feet
b. 8-1/2 feet
c. 8 feet
d. 6 feet

M133. It takes 7 hours to mill 4 pieces. How long will it take to mill 21 pieces?

a. 36 hours and 45 minutes
b. 38 hours and 30 minutes
c. 36 hours
d. 38 hours and 47 minutes

M134. What is the circumference of a pully that is 4.5 inches in diameter?
a. 13.3 inches
b. 14.3 inches
c. 14.1 inches
d. 13.6 inches

M135. One thousandth of an inch in decimal form is:

a. 0.1
b. 0.01
c. 0.001
d. 0.0001

M136. What is the weight of 12 chisels if each one weighs 1 3/4 pounds?

a. 12 1/4 pounds
b. 21 pounds
c. 20 3/4 pounds
d. 36 pounds

M137. The motor driving a milling machine supplies 5 HP. If 1/8 HP is lost in the belts, 1/3 HP is lost in the gears, and 1/6 HP is consumed by friction in the bearings, what power is delivered to the cutter?

a. 4 3/8 HP
b. 4 1/8 HP
c. 4 HP
d. 4 3/4 HP

M138. A piece of cast iron 4 1/8 inches thick was planed to a thickness of 3 31/32 inches. What thickness of metal was removed?

a. 1 1/8 inches
b. 1 inch
c. 1 3/8 inches
d. 5/32 inches

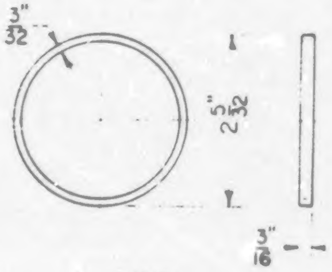
M139. How much would a dozen taps cost at 87.5 cents each?

a. $10.44
b. $10.00
c. $10.50
d. $10.45

M140. Seventeen taps cost $10.50. How much would seven taps cost?

a. $4.32
b. $4.43
c. $4.25
d. $4.52

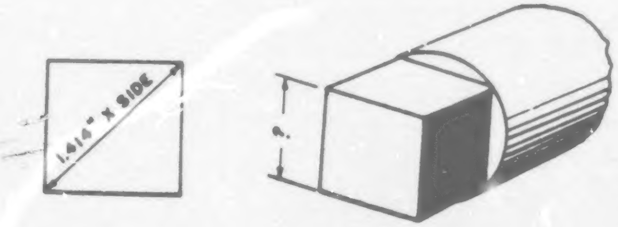
M141. What is the inside diameter of the ring shown below?



RING

a. 65/32 inch
b. 2 inches
c. 1 15/32 inches
d. 1 31/32 inches

M142. The distance across the corners of a square is always equal to 1.414 times the length of one side of the square. How large a square can be machined on the end of a shaft which measures 7.070 in diameter?



a. 3 inches
b. 4 inches
c. 5 inches
d. 6 inches

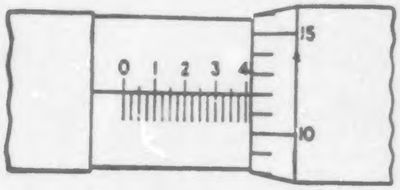
M143. Layout lines scribed with a height gauge should be:

a. only deep enough to remove the layout dye
b. scribed so that a permanent mark is left in the work
c. short dashed lines
d. scribed repeated times to insure a visible mark

M144. What part of a micrometer assures repeated equal measuring pressure?

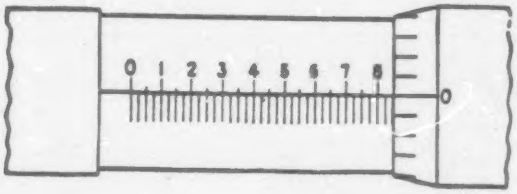
a. friction spindle
b. spindle lock
c. thimble
d. pressure regulator

M145. What is the reading in the figure shown below?



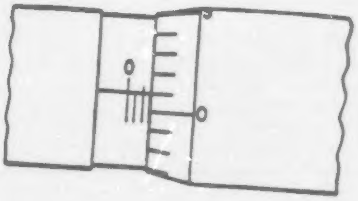
a. .410
b. .437
c. .412
d. .041

M146. What is the reading in the figure shown below?



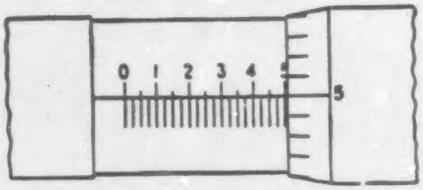
a. .850
b. .900
c. .840
d. .825

M147. What is the reading in the figure shown below?



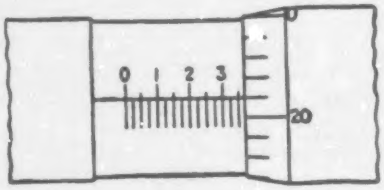
a. .074
b. .051
c. 1.051
d. .076

M148. What is the reading in the figure shown below?



a. .530
b. .505
c. .520
d. .055

M149. What is the reading in the figure shown below?



a. .371
b. .321
c. .379
d. .479

M150. As gauge blocks are dissembled and replaced, they are:

a. thoroughly cleaned
b. coated with preservative
c. handled only with cloth or tissue
d. all of the above

M151. Corrosion of gauge blocks is caused by:

a. leaving the blocks wrung for extended periods of time
b. handling the blocks
c. using incorect preservatives
d. all of the above

M152. A file cuts:

a. only on the forward stroke
b. only on the return stroke
c. on the forward and return strokes
d. best with very short strokes

M153. Which of the following conditions will cause a hacksaw to dull quickly?

a. sawing too slow
b. sawing too fast
c. placing no pressure on the return stroke
d. using a blade that is too short

M154. It is a good general rule when selecting a hacksaw blade to use a:

a. coarse pitch for hard materials
b. fine pitch for soft materials
c. blade with at least three teeth in contact with the cutting edge
d. blade with the greatest number of teeth per inch possible

M155. The pitch of a hacksaw blade is the same as the:

a. set of the blade
b. thickness of the blade
c. number of teeth per inch
d. kerf cut by a blade

M156. A hacksaw cut can be started easily by:

a. using short, quick strokes
b. drawing the saw backwards
c. marking the starting point with a center punch
d. marking the starting point with a file

M157. The twist bit used to make a hole prior to tapping is called a:

a. tapping bit
b. drill tap
c. tap drill
d. punch drill

M158. Threads in a blind hole should be completed with a:

a. bottoming tap
b. finishing tap
c. taper tap
d. blind tap

M159. Internal hole threads are cut with a:

a. die
b. tap
c. threader
d. thread cutter

M160. The crest and root of American National threads are:

a. flat
b. sharp
c. square
d. round

M161. The smallest diameter of a thread is also the:

a. crest diameter
b. root diameter
c. largest diameter
d. minor diameter

M162. The top of a thread is called the:

a. root
b. pitch
c. crest
d. crown

M163. External threads are cut with a:

a. tap
b. die
c. thread cutter
d. threader

M164. Dies are held and turned with die:

a. wrenches
b. cutters
c. stocks
d. clamps

M165. Hand reamers can readily be identified by the:

a. length of the flutes
b. length of the body
c. markings on the back
d. square on the shank

M166. A hole with a slot in it would be reamed with a:

a. short starting reamer
b. spiral or helical flute reamer
c. slightly undersized reamer
d. straight flute reamer

M167. The operation of a hand reamer in reverse results in:

a. a very smooth finish
b. long stringy chips
c. a dull reamer
d. a reduction of heat buildup

M168. Which of the following statements is true of hand reaming operations?

a. the reamer always aligns itself with the existing hole
b. reamer alignment is checked with a square
c. holes produced by one reamer will vary in size
d. the length of the flutes determines the depth of the hole

M169. Which of the following hand reamers would result in a reduction of chatter?

a. high speed steel
b. carbon steel
c. spiral flute
d. straight flute

M170. How much pressure should be applied when pressing in a bushing with an arbor press?

a. between 10 and 30 tons
b. just enough to push the bushing through the bore and seat it
c. just enough to start the bushing into the hole
d. about 5 tons

M171. What should always be done before pressing in a bushing?

a. chamfer and lubricate the bore
b. clean all the oil off the bushing
c. oil the bushing and start in the bore with a hammer
d. none of the above

M172. The depth stop on a dill press is used to:

a. keep the quill from falling out at full length
b. limit the stroke and prevent the drill from drilling the table
c. alert the operator when the drilling tool reaches the depth desired
d. detect when the drilling tool approaches the depth desired

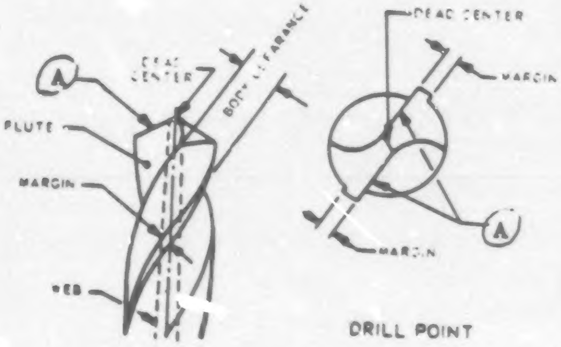
M173. Parallels are used on the drill press for:

a. spacing workpieces off the drill press table or vise
b. aligning a center punch mark on round stock in V-blocks
c. scribing a parallel line along a shaft
d. heavy, rough drilling

M174. V-blocks are generally used on the drill press for:

a. holding round stock for cross drilling
b. holding round stock in a vertical position to drill deep holes lengthwise to the material
c. a substitute step block
d. quick drilling jobs without the need of clamps or hold downs

M175. What is the name of the drill bit section labeled A in the figure below?



a. lip cutting edge
b. shear angle
c. knife
d. tang

M176. If the drilling speed is too slow for both the diameter of the drill and the material being drilled:

a. the margins or outer corners are broken down
b. more feed is required to get the drill to cut, and it often breaks
c. chips become jammed in the flutes
d. all of the above

M177. Jamming of drills when drilling deep holes can be avoided by using a procedure called:

a. alternating
b. pecking
c. withdrawal
d. chipping

M178. What is the head angle of most commonly used flat head screws?

a. 52
b. 60
c. 72
d. 82

M179. What is the reaming stock allowance in inches for reaming a 1/2 inch diameter hole?

a. .005 inch
b. .015 inch
c. .025 inch
d. .035 inch

M180. Coolant is used while reaming to:

a. wash away chips
b. improve the surface finish
c. cool the tool
d. all of the above

M181. An oversized hole formed during the reaming process is caused by:

a. a build-up of cutting edge
b. a slightly tapered reamer
c. a misaligned reamer
d. all of the above

M182. A bell-mouthed hole formed when reaming is caused by:

a. an oversized reamer
b. a worn reamer
c. a slightly tepared reamer
d. a misaligned reamer

M183. When reaming, a high quality surface is obtained on most metals by:

a. adding coolant/lubricant to the work
b. rotating the reamer in reverse
c. using very small feed rates
d. using a polishing reamer

M184. Chatter during the reaming operation can be eliminated by:

a. increasing the feed
b. decreasing the feed
c. increasing the speed
d. decreasing the speed

M185. A poor quality surface on a reamed workpiece is caused by:

a. a feed rate that is too high
b. a reaming that is too small
c. a cutting speed that is too high
d. all of the above

M186. What is the most important factor to consider when counterboring?

a. cutting speed
b. feed rate
c. kind of coolant used
d. secure fastening of the workpiece

M187. Before starting to counterbore, the operator should:

a. lubricate the pilot
b. lubricate the drill press spindle
c. reduce the feed rate by 1/3
d. all of the above

M188. Grinding wheels have a grade specification which refers to the:

a. strength with which the bond holds the grain
b. relative hardness of the abrasive grain in the wheel
c. dollar value of the abrasive grain
d. relative hardness of the bond in the wheel

M189. Grinding wheel dressing and truing are:

a. essentially the same operation
b. performed with the same equipment
c. different terms for the same operation
d. important only for form grinding

M190. When a grinding wheel is rotating clockwise, the correct position for the single point diamond in a dresser is:

a. pointing in the direction of rotation 15° past the center line
b. pointing in the direction of rotation 15° ahead of the center line
c. at a 15° angle directly on the vertical center line
d. at a point about midway between high and low

M191. A rough cutting grinding wheel usually incorporates what type of bond?

a. shellac
b. rubber
c. vitrified
d. resinoid

M192. What is the preferred abrasive for grinding most steels?

a. diamond
b. silicon carbide
c. cubic boron nitride
d. aluminum oxide

M193. Grit sizes for most machine shop grinding wheels fall in the range of:

a. 8 to 36
b. 36 to 120
c. 120 to 240
d. 280 and fewer

M194. Grinding wheel loading occurs when the wheel:

a. grade is too soft
b. has the wrong abrasive
c. grit size is too coarse
d. structure is too dense and abrasive too fine

M195. Glazing occurs when the grinding face of a wheel becomes shiny and smooth. It is an indication that the wheel:

a. grade is too hard
b. has the wrong abrasive
c. grit size is too coarse
d. structure is too open

M196. The correct wheel dressing on a surface grinder is important because it:

a. prevents grinding problems
b. makes the wheel cut well and fast
c. produces a satisfactory finish
d. prevents wheel loading

M197. The first thing to check if you observe chatter marks during surface grinding is:

a. vibration
b. wheel dressing
c. wheel grade or hardness
d. abrasive grit size

M198. A surface grinder is generally used to grind:

a. any kind of surface
b. cylindrical surfaces
c. flat surfaces
d. formed surfaces

M199. The basic accessory in grinding surface work is:

a. an angle plate
b. a magnetic sine chuck
c. a V-belt
d. a clamp

M200. The most precise handwheel on the surface grinder is the:

- a. down feed
- b. cross feed
- c. traverse
- d. chuck

M201. Why is a burnished surface not desirable?

- a. poor appearance
- b. deviates from pattern requirements
- c. does not wear well
- d. is discolored

M202. Too much grinding heat can cause:

- a. discoloration
- b. "fishtails"
- c. work that is out of parallel
- d. all of the above

M203. What control on the lathe is used only for threading?

- a. half nut lever
- b. feed change lever
- c. trembler levers
- d. feed reverse lever

M204. What control is used with the thread dial indicator?

- a. half nut lever
- b. feed change lever
- c. clutch knob
- d. feed reverse lever

M205. The carriage of the lathe rides on the:

- a. headstock
- b. tailstock
- c. ways
- d. column

M206. The gear box tumbler levers on the lathe affect the:

a. speed
b. direction
c. length of travel
d. feed

M207. The cross slide on the lathe moves:

a. parallel to the ways
b. perpendicular to the ways
c. up and down
d. in a circle

M208. What is the most common use of the dial indicator on the lathe?

a. measures diameters
b. measures tapers
c. measures differences in diameters
d. centers work

M209. The binding lever on the tailstock prevents what part of the lathe from moving?

a. tailstock
b. dead center
c. live center
d. spindle

M210. Which of the following components is usually used to mount flat stock in the lathe?

a. four-jaw chuck
b. tailstock
c. faceplate
d. carriage

M211. Excessive overhang of the tool and tool holder on roughing cuts can cause:

a. chatter and broken tool points
b. the tool to swing into the lathe dog
c. the feed rate to change
d. all of the above

M212. Which of the following procedures results in a slow lathe speed?

a. disengage the back gear
b. lock in the bull gear
c. release the bull gear pin
d. tighten down on the knockout bar

M213. In which kind of chuck is square or rectangular work set up for facing?

a. universal
b. collet
c. independent
d. six-jaw

M214. A right hand facing tool is used for facing:

a. centered shaft ends and sharp corners
b. chucked shafts and large workpieces in chucks
c. rough work where a heavy duty facing tool is needed
d. smooth surfaces

M215. Driving force is transmitted to the workpiece when turning between centers by means of a:

a. three or four-jaw chuck
b. drive plate and lathe dog
c. trip dog that automatically stops rotation at a predetermined point
d. collet and drawbar

M216. The dead center is correctly adjusted by turning the tailstock handwheel until a resistance is felt and then:

a. stopping
b. backing off so there is some end play
c. turning in 1/4 turn
d. backing off until the dog bent tail clicks freely in its slot

M217. The dead center should be adjusted frequently between cuts because the:

a. heat of machining expands the work and tightens it
b. machine adjustments often vibrate loose during machining operations
c. metal in the workpiece center wears and causes the centers to become loose
d. all of the above.

M218. Round material such as shafts should be laid out on the end for center drilling in a drill press by using a:

a. hermaphordite caliper
b. center head and plate
c. height gauge and V-blocks
d. all of the above

M219. Center drills break as a result of:

a. too heavy feed and too low speed
b. too light feed and too high speed
c. dropping on the floor
d. allowing chips to foam a tangle around them

M220. Drilling in too far with a center drill:

a. makes the taper too large and heats it up
b. damages the center drill on the tapered section
c. makes a sharp outer edge which is a poor bearing surface
d. causes the chips to jam and the drill to heat up

M221. A workpiece is center drilled in the lathe for the purpose of:

a. turning between centers only
b. spotting a hole for drilling or for turning between centers
c. placing it on a mandrel and for turning between centers
d. facing to the center of the workpiece

M222. Which of the following lathe tools drives or turns the workpiece when machining between centers?

a. dog
b. chuck
c. line center
d. mandrel

M223. The main advantage of boring over reaming in the lathe is that:

a. boring corrects any eccentricity in the bore
b. boring corrects axial misalignment
c. better finishes are obtained
d. the boring operation can be performed quicker than the reaming operation

M224. What operation enlarges holes to the exact size?

a. drilling
b. reaming
c. boring
d. sizing

M225. Which of the following reactions is an indication that a drill is being fed too lightly into the work?

a. drill breaks
b. drill heats up
c. cutting edge becomes chipped
d. drill chatters

M226. Which of the following conditions is a requirement for drilling holes over 1/2 inch with the lathe?

a. 1/8 inch pilot hole
b. center punched starting hole
c. 120 beveled hole 1/4 inch deep
d. pilot hole equal to the web thickness of the desired drill size

M227. Drills smaller than 1/2 inch are:

a. not used on the lathe
b. held in a jacob's chuck
c. held in the tailstock spindle
d. held in the drill holder

M228. Taper shank drills are usually held in the:

a. tailstock spindle
b. lathe dog
c. drill holder
d. headstock chuck

M229. What is the purpose of knurling?

a. tool handles, gripping surfaces, and appearance
b. press fits, appearance, and gripping surfaces
c. press fits, tool handles, and error disguise
d. none of the above

M230. Ordinary knurls make a pattern on the workpiece by:

a. cutting the material
b. displacing the material
c. compressing the material
d. all of the above

M231. The Acme threading tool forms an included angle of how many degrees?

a. 29°
b. 30°
c. 55°
d. 60°

M232. Before cutting coarse screw threads on the lathe, the operator should lubricate the:

a. leadscrew and gearbox
b. ways and cross slide
c. carriage and half nuts
d. all of the above

M233. The Acme tool is aligned to the work with:

a. a square
b. the eye
c. an Acme tool gauge
d. a center gauge

M234. Threads are cut or chased on a lathe with a single point tool by:

a. making a series of cuts in the same grooves
b. using a threading die
c. moving the carriage by means of the rack that is located under the front way
d. setting the correct feeds on the quick-change gearbox

M235. Threading tools are checked for accuracy on the 60° angle by using a:

a. thread gauge
b. center gauge
c. screw pitch
d. tool angle gauge

M236. During the threading operation, the carriage is moved along the ways by:

a. a gear train on a rack
b. the feed rod spline or keyway
c. the lead screw thread
d. the handwheel

M237. Left hand threads are cut by:

a. turning the tool upside down, reversing the rotation of the spindle, and moving the tool from left to right
b. using a standard tool, reversing the lead screw, and moving the tool from left to right
c. making a right hand thread and turning it end for end
d. using a left hand threading die

M238. In which of the following components is a die usually mounted when cutting threads?

a. headstock
b. tailstock
c. tool post and carriage
d. hand die holder

M239. The standard V thread is:

a. 30°
b. 45°
c. 60°
d. 75°

M240. Very small internal Acme threads are made with:

a. Acme tap sets
b. special boring bars
c. broaches
d. none of the above

M241. Tap drill charts are usually based on what percent of threads?

a. 60%
b. 70%
c. 75%
d. 80%

M242. Where should the compound rest be swiveled in order to cut internal right hand threads?

a. right 29°
b. left 29°
c. 90°
d. right 60°

M243. Which of the following tools is the best choice to measure threads per inch of an internal thread?

a. rule
b. tap
c. screw pitch gauge
d. screw plug gauge

M244. Deflection of the boring bar when cutting internal threads causes:

a. a tapered thread
b. an undersized, often bell-mouthed thread
c. an oversized thread with taper
d. none of the above

M245. Very precise tap drilled holes may be made by:

a. reaming
b. boring
c. drilling first with a slightly smaller drill
d. all of the above

M246. How are tapers sized?

a. in millimeters per foot and in radii
b. by included angles and by degrees and minutes
c. by measuring the offset of the tailstock and by measuring the length of the taper
d. in degrees and minutes or by taper per inch or taper per foot

M247. Two methods of turning a taper on a lathe are:

a. compound slide and offset tailstock
b. plain and telescoping
c. standard and interlocking
d. common and collapsing

M248 Tapers may be measured when work is in the lathe by using a:

a. rule and micrometer caliper
b. taper micrometer
c. taper plug or ring gauge
d. all of the above

M249. The taper attachment bar is directly connected to the:

a. carriage
b. tool post
c. compound rest
d. cross slide

M250. The spindle brake on a vertical milling machine is used:

a. when changing tools
b. to change the spindle speed gauge
c. when engaging the power feed
d. all of the above

M251. The spindle speed range on the vertical milling machine is changed from high to low with:

a. the spindle motor running
b. the spindle coasting
c. the spindle stopped
d. none of the above

M252. A workpiece which is to be clamped to the machine table can be aligned with the table axis by:

a. placing it against stops in the T-slots
b. measuring from the edge of the table to the side of the workpiece
c. indicating the side of the workpiece
d. adjusting the vise jaws

M253. When aligning a work head, the head clamps should be:

a. tight
b. loose
c. exerting a slight drag
d. removed

M254. When aligning a work head, the indicator preload should be approximately:

a. .005 inch
b. .015 inch
c. .030 inch
d. .045 inch

M255. Angular cuts on workpieces can be made:

a. with the peripheral teeth on an end mill
b. by tilting the workpiece
c. by tilting the work head
d. all of the above

M256. A chip screen on a shaper is:

a. a safety device to control flying chips
b. a device to remove cutting oil from chips before they are salvaged
c. a device to separate chips by size for salvage
d. none of the above

M257. A toe dog on a shaper is a:

a. special type of strap clamp
b. holddown piece for the work
c. fitting that goes into a T-slot
d. device for setting the stroke length on a hydraulic shaper

M258. What type of shaper vise is best used for holding workpieces that are not parallel?

a. fixed base vise
b. single screw swivel base vise
c. serrated jaw single screw vise
d. serrated jaw multiple screw vise

M259. A shaper fixture:

a. locates the cutting tool in relation to the workpiece
b. is attached to the machine with straps and stops
c. is a workholding device for rapid location
d. is serrated on the clamping surface to prevent slippage of the part under the load of cutting

M260. Shaper tools prepared for cast iron usually have:

a. less side and end clearance than tools prepared for steel
b. greater side and end clearance than tools for steel
c. less side and back rake than tools for steel
d. more side and back rake than tools prepared for steel

M261. Finishing speeds on shapers are usually:

a. much lighter than shallow roughing speeds
b. lower than deep roughing speeds
c. about 1/3 less than shallow roughing speeds
d. much higher than deep roughing surfaces

M262. What limitations to depth of cut and feed rate are there in shaping?

a. workholding
b. machine power and rigidity
c. workpiece configuration and strength
d. all of the above

M263. The number of people allowed within a safety zone is:

a. none
b. 1
c. 2
d. 3

M264. For maximum safety in the machine shop, long sleeves should be:

a. rolled up above the elbow
b. not be worn
c. rolled down and buttoned
d. rolled up between the wrist and elbow

M265. The first step when lifting an object is to:

a. bend your knees and squat down
b. size up the load to determine if it is within your lifting capacity
c. lean over the load and lift it slightly to determine how heavy it is
d. weigh the load to determine whether or not it is over 50 pounds

M266. Whenever possible, it is best to lubricate machines when they are:

a. down for repair
b. running under load
c. running under no load
d. stopped

M267. When you have something important to say to a person operating a machine, you should:

a. tap the person on the shoulder
b. turn off the machine being used
c. shout in the person's ear
d. wait until the person shuts off the machine

M268 **Task** Cut threads with hand die

Tools and Materials Required

1. Assorted Dies
2. Die Stock
3. Lubricant
4. Measuring Tools
5. GO NO GO Thread Plug Gauge
6. Work-Holding Device
7. Square
8. Layout Die
9. Scriber
10. Blueprint

Conditions The student should be given a workpiece, blueprint and threading tools with the instructions to cut by hand a thread on the workpiece.

Specifications The threaded work should fit a GO NO GO gauge and be within a tolerance of ± 1/64 inch in length and/or meet blueprint specifications

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Checked blueprint for size and length and selected correct die and die stock		
2. Prepared workpiece for threading		
a. ground or machine beveled end		
b. mounted the workpiece in the workholding device		
c. marked-off the length of the thread		

M268 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
3. Threaded workpiece with die		
a. used lubricant-cut oil		
b. started on chamfered part of die		
c. started die square with workpiece		
d. occasionally checked threads with gauge and and adjusted die if necessary		

Was correct procedure followed? ______Yes ______No

Does threaded work meet specifications? ______Yes ______No

M269 **Task** Drill holes with portable drill

Tools and Materials Required

Portable Variable Speed Drill
Drills
Center Punch
Hammer
Square
Work-Holding Device
Drill Gauge
Cutting Oil
Blueprint

Condition The student should be given a workpiece, portable variable speed drill, blueprint, drilling equipment and instructions to drill the workpiece to blueprint specifications.

Specifications The drilled hole should be within a tolerance of ± 1/64 inch and/or meet blueprint specifications.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Located and center punched hole in workpiece		
2. Mounted workpiece in work-holding device		
3. Selected drill		
a. checked drill size with drill gauge		
b. checked sharpness of drill		

M269 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
4. Mounted drill in portable drill		
a. checked for ground		
b. tightened drill on drill chuck		
5. Put on safety glasses		
6. Drilled hole		
a. held drill perpendicular to workpiece		
7. Deburred hole		

Was correct procedure followed? _____Yes _____No

Does threaded work meet specifications? _____Yes _____No

M270 **Task** Ream hole to size

Tools and Materials

1. Drill press
2. Work-holding device
3. Center drill
4. Drills
5. Reamers
6. Cutting oil
7. Vernier micrometer caliper
8. Hole gauge
9. Deburring tool

Conditions Student should be furnished with a blueprint, workpiece and drill press with accessories. Instructions should be given to ream a hole in the workpiece to drawing specifications.

Specifications Hole should be reamed to drawing specifications to a tolerance of ± .005 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Set drill press speed for drilling		
2. Secured work in holding device		
3. Aligned workpiece and center drill		
4. Checked rigidity of set up		
5. Center drilled workpiece, lubricating as required		
6. Selected correct drill		
7. Drilled workpiece to specifications, lubricating as required		

M270 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
8. Selected correct reamer		
9. Set speed		
10. Reamed hole		
11. Cleaned and deburred hole		
12. Removed reamer from hole		

- -

Was correct procedure followed in reaming hole?

______Yes ______No

Was hole reamed to blueprint specifications and tolerance of

± .005 inch? ______Yes ______No

M271 **Task** Countersink hole to specifications

Tools and Materials

1. Drill press
2. Work-holding device and accessories
3. Center punch
4. Hammer
5. Center drill
6. Cutting oil
7. Countersink
8. Precision measuring instruments

Conditions The student should be furnished with a workpiece and blueprint. Instructions should be given to countersink a hole to blueprint specifications.

Specifications Student must countersink hole to blueprint specifications.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Center punched hole location		
2. Secured workpiece in work-holding device		
3. Secured center drill in chuck and set speed		
4. Selected proper drill bit		
5. Drilled hole in workpiece		
6. Selected and mounted countersink		
7. Aligned countersink to hole		
8. Set proper cutting speed		
9. Applied cutting oil		
10. Set stop		

M271 (continued)

- -

Did student follow correct procedure to countersink hole?

_______Yes _______No

Did hole meet blueprint specifications?

_______Yes _______No

M272 **Task** Drill hole to size

Tools and Materials

1. Drill press
2. Work-holding device
3. Combination drill and countersink
4. Deburring Tool
5. Cutting oil
6. Micrometer caliper
7. Small hole gauges
8. Steel rule
9. Depth micrometer
10. Clamps
11. Drills
12. Machinist's Handbook
13. Lubricant
14. Center punch
15. Ball peen hammer

Conditions	The student should be furnished with a workpiece and blueprint. Instructions should be given to drill a hole in the workpiece on the drill press.
Specifications	The hole must be drilled to blueprint specifications to a tolerance of ± 1/64 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Secured workholding device and checked setup for rigidity		
2. Located position of hole with light layout lines		
3. Center punched a distinct impression at the intersection of the lines		
4. Aligned workpiece with center drill in chuck		

M272 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
5. Calculatd speed		
6. Set speed		
7. Center drilled workpiece		
8. Selected and mounted drill		
9. Reset speed		
10. Drilled hole to specifications using lubricant as required		
11. Deburred hole		

- -

Did student use correct procedure to drill hole?

______Yes ______No

Did hole meet blueprint specifications and a tolerance of ± 1/64 inch?

______Yes ______No

M273 **Task** Straighten workpiece with arbor press

Tools and Materials

1. Arbor press
2. Dial indicator
3. Work-holding device
4. Support blocks

Conditions The student should be furnished with a bent workpiece and equipment needed to straighten the workpiece.

Specifications The workpiece must be straightened to within a tolerance of ± .002 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Checked workpiece location and amount of runout with dial indicator		
2. Marked location on workpiece		
3. Mounted workpiece correctly on arbor press with supports		
4. Checked workpiece with dial indicator		

Was correct procedure followed to straighten workpiece?

_______Yes _______No

Was workpiece straightened to within a tolerance of ± .002 inch?

_______Yes _______No

M274 **Task** Ream holes with hand reamers

Tools and Materials

1. Work-holding device
2. Reamers
3. Square
4. Tap wrench
5. Lubricant
6. Precision measuring instrument
7. GO NO-GO plug gauge

Conditions The student should be furnished with a blueprint, workpiece and hand tools. The student should be given instructions to ream the hole.

Specifications The hole must be reamed to a tolerance of ± .001 inch and/or blueprint specifications.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Secured workpiece to work-holding device		
2. Selected correct reamer		
3. Mounted reamer in tap wrench		
4. Checked for squareness with workpiece		
5. Reamed hole using lubricant as required		

- -

Was correct procedure followed to ream hole? ______Yes ______No

Was hole reamed to tolerance of ± .001 inch and/or blueprint specifications? ______Yes ______No

M275 **Task** Polish metal

Conditions The student should be furnished with a workpiece, blueprint, and polishing equipment. The student should be given instructions to polish the workpiece on the buffer.

Specifications The workpiece must be polished to blueprint specifications.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Selected buffing wheel and compound		
2. Applied compound to revolving wheel		
3. Buffed workpiece checking frequently for imperfections		

Was correct procedure followed in polishing workpiece?

_______Yes _______No

Was workpiece polished to blueprint specifications?

_______ Yes _______No

M276 **Task** Measure work with a 6 inch pocket rule

Tools and Materials

1. Workpiece
2. Blueprint
3. 6 inch rule

Conditions Student should be given a workpiece, bluerpint, and 6 inch pocket rule. Instructions should be given to measure the workpiece.

Specifications Measurement must be within a tolerance of ± 1/64 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Cleaned and deburred workpiece		
2. Checked blueprint for required dimension		
3. Measured workpiece		

Was correct procedure followed in measuring work?

______Yes ______No

Was measurement within a tolerance of ± 1/64 inch?

______Yes ______No

M277 **Task** Check work with surface gauge

Tools and Materials

1. Surface gauge
2. Combination square
3. Clamps
4. Surface plate
5. Workpiece
6. Files

Conditions Student should be furnished with a workpiece and measuring instruments. Student should be given instructions to check the height of the workpiece.

Specifications Measurement must be within a tolerance of 1/64 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Cleaned surface plate		
2. Deburred workpiece		
3. Set surface gauge to workpiece height		
4. Checked height setting of surface gauge against combination square		

- -

Was correct procedure followed in checking height of workpiece?

______Yes ______No

Was measurement within a tolerance of ± 1/64 inch?

______Yes ______No

M278 **Task** Locate holes with transfer screens and punches

Tools and Materials

1. Transfer screws
2. Transfer punches
3. Hammer
4. Pliers
5. Template
6. Hex socket wrenches
7. Clamps
8. Work-holding device
9. Scribe dividers
10. Square blade

Conditions Student should be furnished with a workpiece and a blueprint. Instructions should be given to locate holes in the workpiece with transfer instruments.

Specifications The located holes must meet blueprint specifications.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Workpiece placed in work-holding device		
2. Checked blueprint for location and size of holes		
3. Selected correct transfer tools		
a. transfer screws selected for threaded holes		
b. transfer punches selected for straight holes		
4. Located holes on workpiece using template		

M278 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
5. Inserted transfer punch in template hole and taped with hammer		
6. Center punched marks left by transfer punch or screw		
7. Verified hole locations against blueprint specifications		

Was correct procedure followed in locating holes?

______Yes ______No

Did location of holes meet blueprint specifications?

______Yes ______No

M279 **Task** Cut material with hand hacksaw

Tools and Materials

1. Hacksaw
2. Work-holding device
3. Layed-out workpiece
4. Files
5. Protective material for jaws
6. Cutting oil

Conditions Student should be furnished with a layed-out workpiece, blueprint, copper or other soft metal and hacksaw. Instructions should be given to cut the workpiece to blueprint specifications.

Specifications Workpiece must be cut to within 1/32 inch outside of scribed line.

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Correctly mounted blade in hacksaw frame		
2. Mounted workpiece in work-holding device		
3. Notched workpiece for start of cut		
4. Protected the workpiece from the jaws of the workholding device		
5. Cut workpiece 1/32 inch outside of scribed line.		

M279 (continued)

- -

Was correct procedure used to cut workpiece? _______Yes _______No

Was workpiece cut to within 1/32 inch outside of scribed line?

_______Yes _______No

M280 **Task** Chase external threads

Tools and Materials

1. Lathe
2. Lathe centers
3. Lathe dog
4. Drive plate
5. Lathe chuck
6. Thread tool
7. Thread center tool gauge
8. Tool holder
9. Drill chuck
10. Center drill
11. GO NO GO gauges
12. Screw pitch gauge
13. Lubricant

Conditions	Student should be given a workpiece, blueprint, lathe, and accessories. Directions should be given to chase external threads on the workpiece.
Specifications	The threads must be cut to blueprint specifications and fit GO NO-GO thread ring gauges.

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Chucked workpiece in lathe		
2. Selected and set speed		
3. Faced and center drilled workpiece		
4. Secured work between centers		
5. Set compound rest to thread specifications (29° or 30°)		

M280 (continued)

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
6. Mounted and aligned cutter tool bit with gauge		
7. Set gear box and headstock gears		
8. Set lathe speed to slow		
9. Made thread dial selection		
10. Cut threads to specifications		
11. Filed burrs during threading operation		
12. Used lubricant as required		
13. Measured thread with GO NO-GO thread ring gauge		

Was correct procedure followed as threads were chased?

______Yes ______No

Were the threads cut to blueprint specifications and fit GO NO-GO thread ring gauges? ______Yes ______No

M281 Task Dress and true grinding wheel on pedestal grinder

Tools and Materials

1. Pedestal grinder
2. Grinding wheel
3. Mechanical wheel dresser
4. Wrenches
5. Machinist's Handbook

Conditions: The student should be furnished with a pedestal grinder and wheel dressers. Instructions should be given to dress and true the wheel.

Specifications: The grinding wheel must have grains and metal particles removed. The wheel must be concentric with the face flat within a tolerance of ± 1/64 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Checked wheel for cranks		
2. Adjusted spark guard to within 1/64 inch of wheel		
3. Selected wheel dresser		
4. Adjusted work rest to allow lugs of wheel dresser to ride on front of work rest		
5. Adjusted safety wheel		
6. Started grinder		
7. Placed dresser lugs against front edge of work rest with no contact with the wheel		

M281 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
8. Held dresser down on work rest and moved across face of wheel		
9. Continued passes until wheel was dressed and true		

Was the correct procedure used to dress and true the wheel?

______Yes ______No

Was the wheel concentric with the face flat within a tolerance of 1/63 inch?

______Yes ______No

M282 **Task** Use a surface grinder

Tools and Materials

1. Surface grinder
2. Polishing wheel
3. Polishing compound

Specifications The student should be furnished with a workpiece, blueprint, and polishing equipment. Instructions should be given to polish the workpiece to blueprint specifications.

Conditions The workpiece must be polished to blueprint specifications.

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Selected and mounted polishing wheel		
2. Selected and set speed		
3. Secured workpiece		
4. Applied compound to polishing wheel		
5. Polished workpiece, checking as required		

Was correct procedure followed in using surface grinder to polish workpiece? ______Yes ______No

Was workpiece polished to blueprint specifications?

______Yes ______No

M283 Task Align lathe centers

Tools and Materials

1. Lathe
2. Test bar
3. Centers
4. Dial indicator
5. Wrenches

Conditions	The student should be furnished with a lathe and measuring instrumnts. Instructions should be given to align the lathe centers.
Specifications	Centers must be aligned to a tolerance of .0005 inch.

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Cleaned centers and spindle holes		
2. Mounted centers		
3. Checked alignment of center in headstock		
4. Checked index marks on tailstock		
5. Checked centers together for rough alignment		
6. Mounted test bar between centers		
7. Mounted indicator on tool post		
8. Checked indicator against test bar		
9. Set indicator dial at zero at one end of test bar		

M283 (continued)

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
10. Checked test bar with dial indicator at each end		
11. Adjusted tailstock to tolerance required		

Was correct procedure used to align lathe centers?

_______Yes _______No

Was center aligned to a tolerance of ± .0005 inch?

_______Yes _______No

M284 **Task** Align workpiece in four-jaw chuck

Tools and Materials

1. Lathe
2. Workpiece
3. Four jaw independent chuck
4. Dial indicator
5. Chalk
6. Wrenches

Conditions	Student should be furnished with a workpiece and measuring instrument. Instructions should be given to align the workpiece in the four jaw chuck.
Specifications	Workpiece must be aligned to a tolerance of ± .001 inch.

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Mounted workpiece in four jaw chuck		
2. Centered workpiece using chalk and two opposite jaws		
3. Mounted indicator on toolpost		
4. Checked one pair of opposite jaws with indicator against workpiece		
5. Adjusted half of error		
6. Checked other opposite jaws and adjusted half of error		
7. Repeated steps 4-6 until workpiece was within tolerance and all jaws were tightened		

M284 (continued)

Was correct procedure followed to align the workpiece?

_______Yes _______No

Was workpiece aligned to a tolerance of ± .001 inch?

_______Yes _______No

M285 Task Align workpiece on faceplate

Tools and Materials

1. Wrenches
2. Soft hammer
3. Chalk
4. Clamps
5. Straps
6. Bolts
7. Lathe
8. Dial indicator
9. Faceplate

Conditions

Student should be furnished with a lathe, workpiece, and measuring tools. Instructions should be given to align the workpiece on the lathe faceplate.

Specifications

The workpiece must be aligned to an accuracy of ± .001 inch.

Procedures	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Mounted workpiece on faceplate using straps or bolts and a counter balance weight if necessary.		
2. Roughly lined up the workpiece, tightening clamps lightly and turning lathe by hand		
3. Adjusted workpiece using chalk or toolholder end		
4. Mounted indicator		
5. Adjusted workpiece to required accuracy using the indicator		

M285 (continued)

- -

Was correct procedure used to align the workpiece on the faceplate?

_______Yes _______No

Was workpiece aligned to an accuracy of ± .001 inch?

_______Yes _______No

M286 **Task** Rough cut workpiece on lathe

Tools and Materials

1. Lathe
2. Work-holding device
3. Cutting tool
4. Micrometer caliper
5. Machinist's Handbook
6. Rule

Conditions Student should be furnished with a workpiece, blueprint and measuring instruments. Instructions should be given to rough cut the workpiece on the lathe.

Specifications The workpiece must meet blueprint specifications and be within a tolerance of ± .005 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Used Machinist's Handbook to calculate speed of the lathe for rough cut		
2. Calculated feed of lathe		
3. Set lathe speed and feed		
4. Measured workpiece and checked blueprint for designated dimension		
5. Mounted workpiece		
6. Mounted cutting tool		
7. Made light cut on workpiece		
8. Measured workpiece for taper and adjusted as necessary		
9. Made rough cut on workpiece		

M286 (continued)

- -

Was correct procedure used to make rough cut? _______Yes _______No

Did cut meet blueprint specifications and fall within a tolerance of ± .005 inch? _______Yes _______No

SHEET METAL

S1. The center head of a combination square is used to:

- a. check the squareness of work
- b. locate the exact center of round stock
- c. gauge depth and height
- d. transfer measurements

S2. Which of the following is not a use of the steel gauge?

- a. checking for straightness
- b. transferring measurements
- c. laying out locations of welded components
- d. dividing angles

S3. Which of the following tools would most likely be used to lay out a circle?

- a. dividers
- b. angle gauge
- c. radius gauge
- d. universal bevel protractor

S4. When scribing layout lines on sheet metal, you should hold the scriber:

- a. leaning toward the direction in which it will be moved and away from the straightedge
- b. as nearly perpendicular to the sheet metal as possible
- c. leaning toward you and toward the straightedge
- d. leaning away from you and away from the straightedge

S5. Which of the following tools should be used to cut a long straight edge on a sheet metal pattern?

- a. squaring sheer
- b. aviation snips
- c. combination snips
- d. pliers

S6. Which of the following hand tools should be used to turn an edge on the end of a sheet metal cylinder?

a. mallet
b. hammer
c. drop hammer
d. bumping hammer

S7. What feature of aviation snips makes it possible for them to cut metal with less effort than with tin snips?

a. longer handles
b. sharper blades
c. compound levers
d. serrated cutting edges

S8. A full-size drawing of the shape of the flat sheet needed to make a sheet metal object is called a:

a. stretchout
b. sketch
c. pattern
d. stretchout or pattern

S9. The pattern development of a cone shape if formed by:

a. radial line development
b. parallel line development
c. converging line development
d. diverging line development

S10. Which of the following parts of a drawing is the actual pattern?

a. side view
b. top view
c. stretchout
d. 3-dimensional

S11. What happens to the edge of a piece of sheet metal that is to be cut when there is too much clearance for the blades of the squaring sheer?

a. it is beveled
b. it has a rounded corner
c. it has a square cut
d. it has a burr

S12. Which of the following items is used to mark a pattern on sheet metal?

a. pencil
b. felt tip pen
c. prick punch
d. scratch awl

S13. Which of the following tools is used to make seams by machine?

a. drill press
b. hammer and mallet
c. box and pan brake
d. seam maker

S14. Which of the following hand tools should be used to form sheet metal over stakes?

a. mallet
b. raising hammer
c. setting hammer
d. hand dolly

S15. The most commonly used mechanical seam, sometimes called the "hammer lock" or "hobo lock" is the:

a. grooved seam
b. standing seam
c. Pittsburgh seam
d. bottom double seam

S16. A center punch should be ground to what angle?

- a. 15°
- b. 30°
- c. 60°
- d. 45°

S17. Which of the following items would require the highest tempering temperature?

- a. steel cutting tool
- b. wood chisel
- c. cold chisel
- d. spring steel part

S18. Which color will show when tempering a steel cutting tool?

- a. blue
- b. light straw
- c. violet
- d. grey

S19. When a carbon steel cutting tool such as a drill is heated to a blue color, it has:

- a. lost its temper
- b. been retempered and is harder
- c. been retempered and is softer
- d. not been affected by the heat

S20. After hardening, tempering should be completed:

- a. within 24 hours
- b. whenever time permits
- c. immediately
- d. if it is needed for a particular job

S21. The Rockwell and Brinell Hardness Testers utilize the specific property of hardness known as:

- a. elastic hardness
- b. resistance to abrasion
- c. resistance to penetration
- d. hardenability

S22. The Rockwell Hardness Tester measures:

a. the rebound
b. the depth of penetration
c. wear
d. the amount of pressure required to penetrate to major depth

S23. Which of the following conditions increase as hardness increases?

a. ductility
b. depth of penetration
c. tensile strength
d. plasticity

S24. A soft form of iron that can be readily cast into molds and is very machinable is called:

a. wrought iron
b. white cast iron
c. grey cast iron
d. low carbon steel

S25. The letter "O" as assigned to tool steels designates:

a. oil hardening steels
b. over stressed steels
c. steels annealed in an oven
d. steels that were made from selected ores

S26. The file hardness test is used to determine:

a. Brinell or Rockwell hardness numbers
b. machinability and relative hardness of metals
c. carbon content of steels
d. all of the above

S27. The letter "T" following the four digit number designating aluminum represents:

a. temper
b. solution heat treatment
c. strain hardened and tested
d. titanium alloyed with aluminum

S28. How is magnesium different than aluminum?

a. brighter
b. stronger
c. heavier
d. lighter

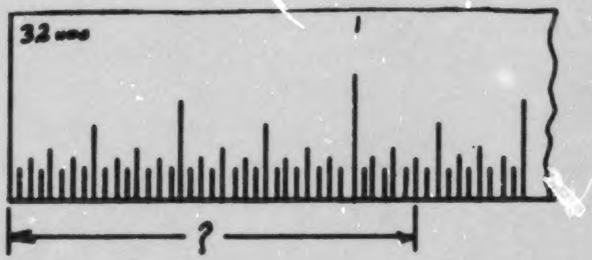
S29. Copper wire is basically pure copper that has been hardened by:

a. strain hardening
b. precipitation hardening
c. heating to 1200° F (649° C) and quenching in water
d. alloying with tin and zinc

S30. High carbon steel is tempered after being hardened in order to:

a. toughen and soften it
b. anneal it
c. give it a good color
d. make the grains smaller

S31. What is the measurement shown on the scale below?



a. 40/42 inch
b. 1 3/16 inches
c. 6/32 inch
d. 1 6/32 inches

S32. Which of the following tools can be used to square sheet metal?

a. set squares
b. squaring shears
c. trammels
d. squaring tools

S39. Solder that is 50/50 is made of:

a. half lead and half antimony
b. half tin and half zinc
c. half zinc and half antimony
d. half tin and half lead

S40. Joints soldered with a corrosive flux must be:

a. annealed
b. cleaned with water
c. brushed
d. tempered

S41. Soldering is:

a. melting two bare metals together
b. melting one bare metal to a parent metal
c. joining two metals with a metal of lower melting temperature
d. another word for welding

S42. Solder flows easier when:

a. the heat is increased
b. flux is used
c. it runs downhill
d. the rosin is burned out

S43. Tinning refers to the process of:

a. adding a light coat of solder to the copper
b. shaping the copper to a point
c. finishing the surfaces flat
d. applying sal ammoniac to the tip of the copper

S44. Metal which is to be hand riveted should:

a. be brittle
b. have low tensile strength
c. be ductile
d. have a high melting point

S45. Which of the following tools is used to draw rivets tight in two pieces of sheet metal?

a. dolly bar
b. hand seamer
c. crimper
d. rivet set

S46. Which of the following rivets should be used when a riveted galvanized sheet steel joint is to be soldered?

a. black iron rivet
b. tinned rivet
c. solid copper rivet
d. hollow rivet

S47. What is the reason for crimping one end of a pipe?

a. strengthens the pipe
b. pipe will fit inside other pipes
c. correct diameter of the pipe will be attained
d. sharp edges will be folded back

S48. Which of the following hand tools is used to make hems, seams, and other straight line bends in thin sheet metal?

a. hand seamer
b. hand groover
c. hand bender
d. hand former

S49. When handling sheet metal, you should always:

a. let it slide through your hands
b. grip it firmly
c. fold sharp edges over before handling
d. tape the edges

S50. Which of the following hand tools is used for testing and checking trueness of an angle or for laying out lines?

a. trammel point
b. straightedge
c. square
d. compass

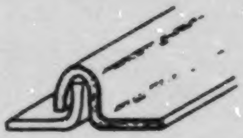
S51. Which of the following points is established to ensure complete accuracy when making layouts?

a. flange
b. baseline
c. border
d. center

S52. Which of the following hand tools is used to layout arcs and circles on metal surfaces?

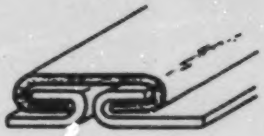
a. protractor
b. trammel point
c. compass
d. flange

S53. The seam pictured below is a:



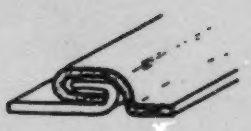
a. Pittsburgh lock seam
b. double hem seam
c. single seam
d. vertical clip seam

S54. The seam pictured below is a:



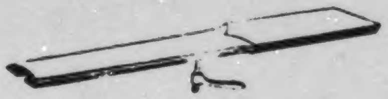
a. double grooved seam
b. groovd seam
c. Pittsburgh lock seam
d. drive-clip seam

S55. The seam pictured below is a:



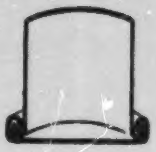
a. corner lap seam
b. grooved seam
c. horizontal lap seam
d. set-in bottom seam

S56. The stake shown below is generally found in every sheet metal shop. It is called a:



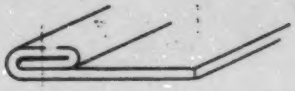
a. hollow mandrel stake
b. conductor stake
c. tea kettle stake
d. blacksmith's stake

S57. The seam pictured below is a:



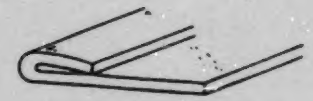
a. inverted seam
b. single seam
c. rolled seam
d. double seam

S58. The hem pictured below is a:



a. single hem
b. double hem
c. rolled hem
d. rectangular rolled hem

S59. The hem pictured below is a:



a. blind edge hem
b. wired edge hem
c. grooved hem
d. single hem

S60. The spaces left when pieces of metal are cut from seams and the edges of patterns are called:

a. boilermaker's lips
b. beads
c. notches
d. grooves

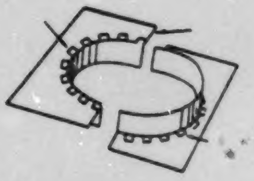
S61. A double hem edge is used in place of a single hem edge when there is a need for more:

a. length
b. strength
c. width
d. brightness

S62. A double hem edge requires an allowance equal to _______ times the width of the hem.

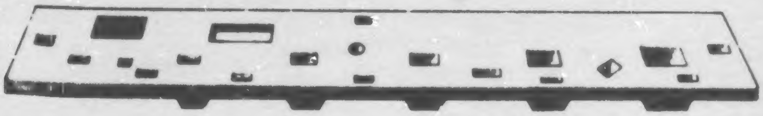
a. 2
b. 4
c. 3
d. 1.5

S63. The seam pictured below is a:



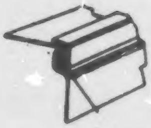
a. dovetail seam
b. corner lap seam
c. burred bottom seam
d. overlap seam

S64. The metal shown below is fastened to a bench and is called a:



a. bench dog
b. stake rack
c. bench plate
d. stake rigger

S65. The seam pictured below is a:



a. lap seam
b. off-set seam
c. Pittsburgh-lock seam
d. set-in bottom seam

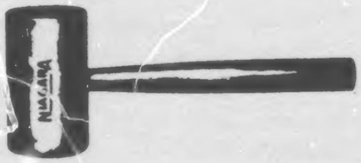
S66. What type of lap seam is stronger than a soldered lap seam?

a. banded
b. riveted
c. double
d. off-set

S67. If a double seam is to be water tight, it must be:

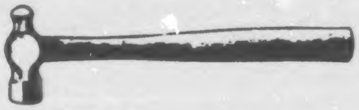
a. crimped
b. soldered
c. rolled
d. beaded

S68. Hammers made entirely of soft materials, as shown in the figure below are called:



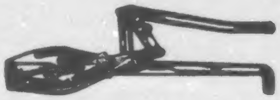
a. raising hammers
b. marking hammers
c. peening hammers
d. mallets

S69. The hammer below, commonly seen in metal shops, is called a:



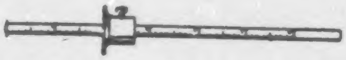
a. setting hammer
b. ball-peen hammer
c. raising hammer
d. sledge hammer

S70. The cutting piece shown below is called a:



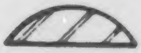
a. combination snips
b. Trojan snips
c. compound lever snips
d. bench snips

S71. The tool below is used by the sheet metal worker for layout. It is called a:



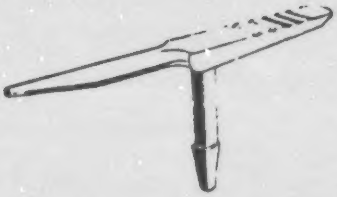
a. scratch or marking gauge
b. trammel point
c. scratch awl
d. combination gauge

S72. The cross section of the file shown below is known as a:



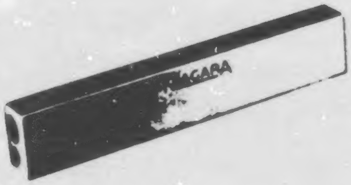
a. pillar file
b. half round file
c. crossing file
d. round file

S73. The stake shown below is often used when creasing metal and bending wire. It is called a:



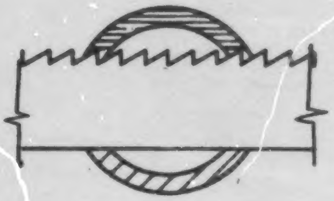
a. creasing stake
b. double seaming stake
c. bevel edge stake
d. solid mandrel stake

S74. The tool pictured below is called a:



a. nail set
b. hand groover
c. hollow punch
d. rivet set

S75. Indicate the sawing principle(s) being violated in the picture below.

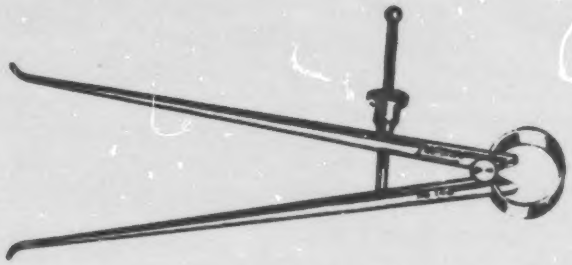


a. pitch is too coarse for the work
b. blade straddles the work
c. teeth are stripping the work
d. all of the above

S76. Which of the following factors should be considered when choosing a hand file for a specific use?

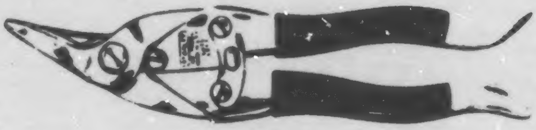
a. amount of material to be removed
b. kind of material to be removed
c. surface finish required
d. all of the above

S77. The measuring device in the figure below is called a:



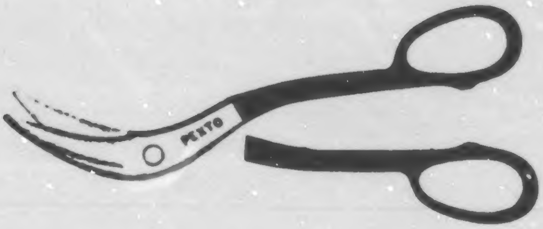
a. surface gauge
b. outside caliper
c. vernier caliper
d. inside caliper

S78. Name the snips shown in the figure below.



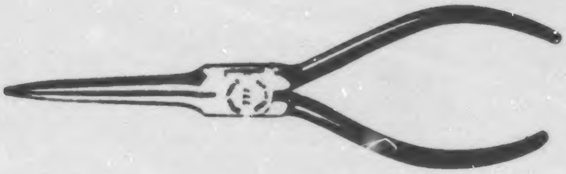
a. hawk billed
b. combination
c. aviation
d. circular

S79. Name the snips shown in the figure below.



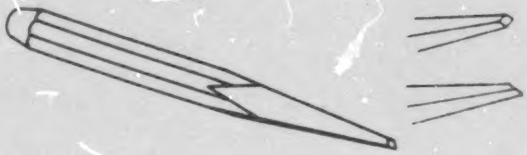
a. hawk billed
b. combination
c. circular
d. aviation

S80. Name the pliers shown in the figure below.



a. diagonal
b. round nose
c. needle nose
d. side-cutting

S81. Name the chisel shown in the figure below.



a. flat
b. diamond point
c. cape
d. round nose

S82. The most common sheet metal screw is a:

a. #4 x 1/2 inch pan head
b. #10 x 3/4 inch pan head
c. #6 x 3/8 inch flat head
d. #10 x 5/8 inch flat head

S83. The two major series of threads are National Course and:

a. American Course
b. American Fine
c. National Fine
d. Standard Fine

S84. The two primary types of threaded fasteners in sheet metal work are sheet metal screws and:

a. wood screws
b. pan head screws
c. lag screws
d. filister head screws

S85. The three most common hammers in sheet metal work are ball peen, setting, and:

a. riveting
b. mallet
c. carpenter's hammer
d. sledge hammer

S86. The size of a peening hammer is designated by its:

a. length in inches
b. weight in pounds
c. weight in ounces
d. force in foot pounds

S87. A combination hammer is used on:

a. large jobs
b. difficult to reach jobs
c. small jobs
d. all jobs

S88. When bending sheet metal with pliers, one should bend:

a. the metal all the way in one quick motion
b. a little at a time
c. as quickly as possible
d. past the bend line

S89. Right-hand aviation snips always cut in what direction?

a. straight
b. left
c. right
d. left and right

S90. What is the heaviest gauge mild steel that bulldog snips can cut?

a. 16-20 gauge
b. 10-12 gauge
c. 14-16 gauge
d. 8-10 gauge

S91. Aviation snips are used for cutting:

a. 12 gauge mild steel
b. heavy rods
c. straight lines
d. circles

S92. Double-cutting snips are especially useful when cutting:

a. wire
b. flat sheet metal
c. round pipe
d. square duct

S93. The lever punch forces metal through a die leaving a:

a. burred hole
b. distorted hole
c. bulged marked hole
d. clean hole

S94. The maximum chuck capicity of a breast drill is:

a. 3/4 inch
b. 3/8 inch
c. 1/4 inch
d. 1/2 inch

S95. What is the maximum drill bit size in the hand drill?

a. 1/2 inch
b. 3/8 inch
c. 1/4 inch
d. 3/4 inch

S96. The connection of single seam is:

a. air-tight
b. water-tight
c. loose
d. leak-proof

S97. To make a single seam water-tight it must be:

a. riveted
b. soldered
c. pressed
d. hemmed

S98. A double seam is not water-proof, but it is:

a. air proof
b. heat proof
c. dust proof
d. leak proof

S99. To minimize stretching, the double seam is always dressed down with a:

a. setting hammer
b. rivet hammer
c. mallet
d. combination hammer

S100. After checking the edges of a grooved seam for proper allowance and tightness of fit, the metal worker must check for:

a. straightness
b. neatness
c. burrs
d. kinks

S101. Three ways of locking a seam are:

a. end rivet, end slit, and prick punch
b. solder, prick punch, and spot weld
c. spot weld, end rivet, and solder
d. spot weld, end slit, and prick punch

S102. If a dovetail seam is to be water-tight it must be:

a. set down
b. grooved
c. welded
d. soldered

S103. What tool is used to cut the notches on a dovetail seam?

a. side cutters
b. hacksaws
c. torches
d. snips

S104. What is the maximum depth to notch a dovetail seam?

a. 1/2 inch
b. 3/4 inch
c. 3/8 inch
d. 1 inch

S105. What tool is used when flanging a curved or irregular job?

a. hatchet stake
b. rivet set
c. hand dolly
d. any round block

S106. The most effective places to use "pop" rivets are in:

a. open areas
b. blind spots
c. overhead positions
d. it does not matter where they are used

S107. How many pulling positions are there on the "pop" rivet gun?

a. one
b. two
c. three
d. four

S108. A hole in the center of a "pop" rivet makes for easy removal. This hole is formed best by:

a. punching
b. drilling
c. pulling
d. knocking

S109. Rivets are easier to solder when they are coated with:

a. lead
b. copper
c. tin
d. steel

S110. If the soldering copper is too large it can cause:

a. copper plating
b. oxidation
c. buckles
d. uneven flow of the solder

S111. When the soldering copper is forged it should be heated until it:

a. melts solder
b. turns dull red
c. burns bright red
d. burns yellow

S112. What is the weight (in pounds) of the bit of a four-pound soldering copper?

a. two
b. four
c. six
d. eight

S113. A gas soldering furnace can quickly produce a heat of:

a. 1200 F
b. 1800 F
c. 3600 F
d. 4800 F

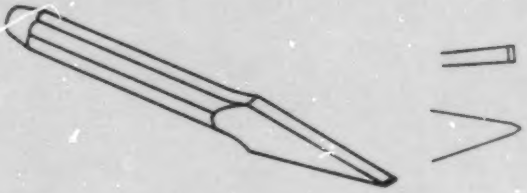
S114. What system in a gasoline fire pot forces fuel into the chamber?

a. liquid pressure
b. gas pressure
c. air pressure
d. water pressure

S115. What is a sal ammoniac block used for in conjunction with a hot soldering tip?

a. straightening
b. shaping
c. forging
d. cleaning

S116. Name the chisel shown in the figure below:



a. round nose
b. flat
c. cape
d. diamond point

S117. Before soldering, a lap seam must be:

a. welded
b. punched
c. riveted
d. tacked

S118. What causes solder to melt during the soldering process?

a. the heat of the soldering copper
b. the heat absorbed in the metal
c. the heat of the fire pot
d. the blue flame of the torch

S119. Soldering beads are used when soldering:

a. corners
b. "pop" rivets
c. bottoms
d. grooved seams

S120. At what angle should twist drill bits be sharpened?

a. 45°
b. 60°
c. 75°
d. 90°

S121. What should be used to cool a drill bit during the sharpening process?

a. warm water
b. cold water
c. thick oil
d. bit paste

S122. Two-pound Tinner's rivets weigh:

a. 2 pounds per 1,000 rivets
b. 2 pounds per 500 rivets
c. 1 pound per 5,000 rivets
d. 2 pounds per 5,000 rivets

S123. Which of the following is not used when lighting and adjusting a soldering copper heating device?

a. main line valve
b. branch line valve
c. cut off valve
d. valve guide

S124. 100% machinability means:

a. metal is very easy to cut
b. metal is very difficult to cut
c. tool angles can be less accurate
d. back rake must be negative

S125. It would be best to strike a hardened surface with a:

a. match
b. chisel
c. soft-faced hammer
d. hardened steel hammer

S126. A metal is considered non-ferrous when it:

a. contains iron
b. contains little or no iron
c. is a mixture of two or more metals
d. contains road salt

S127. A metal is considered ferrous when it:

a. contains iron
b. contains litle or no iron
c. is a mixture of two or more metals
d. contains a base metal

S128. A metal is called an alloy when it:

a. contains iron
b. contains little or no iron
c. contains two or more metals
d. weighs at least 25 lbs.

S129. If the "nominal" dimension on a drawing is 5.000 and the high limit is 5.005 and the low limit is 4.995, what is the tolerance?

a. ± .0005

b. ± .5

c. ± .05

d. ± .005

S130. Hidden edge lines are represented on a drawing by a series of:

a. lines broken by a space twice the length of the line
b. lines broken by a space half the length of the line
c. unbroken parallel lines
d. lines broken by a space greater than the length of the line

S131. When the word "tolerance" is used in reference to a blueprint it means:

a. the amount of variation permitted in the size of a part
b. designation of size without specification of limits
c. basic or nominal size
d. the exact theoretical size from which all limiting variations are made

S132. What does an x mean on a sheet metal pattern?

a. the line is correctly placed
b. there is a hem to be made
c. there is a seam to be made
d. there is a bend to be made

S133. Templates are also known as:

a. stretchouts
b. paper patterns
c. master patterns
d. a & c

S134. Spot welding is a form of:

a. arc welding
b. gas welding
c. resistance welding
d. MIG welding

S135. Sheet metal screws:

a. are self-taping
b. always have 14 threads per inch
c. always have slotted heads
d. are never threaded the full length of the screw

S136. A 10-24 screw:

a. is size 24
b. has 10 threads per inch
c. weighs 10 lbs. per 24 screws
d. has 24 threads per inch

S137. The opeation of corrugating one end of a sheet metal pipe so that it will fit easily into another pipe of the same size is called:

a. reducing
b. shrinking
c. crimping
d. seaming

S138. Which of the following tools should be used to cut a long straight edge on a sheet metal pattern?

a. squaring sheer
b. aviation snips
c. combination snips
d. pliers

S139. Which of the following tools should be used to turn an edge on the end of a sheet metal cylinder?

a. mallet
b. hammer
c. drop hammer
d. bumping hammer

S140. What feature of aviation snips make it possible to cut metal with less effort than with tin snips?

a. longer handles
b. sharper blades
c. compound levers
d. serrated cutting edges

S141. A full size drawing of the shape of the flat sheet needed to make a sheet metal object is called a:

a. stretchout
b. sketch
c. pattern
d. stretchout or pattern

S142. What can happen to the edge of a piece of sheet metal that is cut when there is too much clearance for the blades of the squaring shears?

a. it will be beveled
b. it will have a rounded corner
c. it will have a square cut
d. it will have a burr

S143. Which of the following machines is used to make seams?

a. drill press
b. hammer and mallet
c. box and pan brake
d. seam maker

S144. Which of the following tools is used to form sheet metal over stakes?

a. mallet
b. raising hammer
c. setting hammer
d. hand dolly

S145. The most commonly used mechanical seam, sometimes called the "hammer lock" or "hobo lock" is the:

a. grooved seam
b. standing seam
c. Pittsburgh seam
d. bottom double seam

S146. A center punch should be ground to what angle?

a. 15°
b. 30°
c. 60°
d. 45°

S147. Which of the following tools can be used to square sheet metal?

a. set squares
b. trammels
c. squaring shears
d. squaring tools

S148. Which of the following tools is used to check the squareness of a piece of sheet metal?

a. combination square
b. framing square
c. try square
d. all of the above

S149. What is the first step in squaring a sheet of metal?

a. lay out a square on the metal
b. scribe a set of perpendicular reference lines
c. make approximate cuts and square with a file
d. use the hawk billed snips to trim the metal

S150. What is the maximum thickness that should be cut with tin snips?

a. 16 gauge
b. 20 gauge
c. 22 gauge
d. 24 gauge

S151. When making straight cuts with tin snips, it is best to:

a. keep the jaws 30° to the metal
b. use the full length of the blade for cutting
c. start the cut in the throat of the snip jaws
d. start the cut in the throat of the snip jaws and cut almost
to the end

S152. Which of the following is a hand operated machine that cuts a 90° notch in sheet metal?

a. squaring shear
b. coper
c. notcher
d. squaring punch

S153. Which of the following hand tools is used to make hems, seams, and other straight line bends in thin sheet metal?

a. hand groover
b. hand seamer
c. hand bender
d. hand former

S154. Which of the following characteristics determines the minimum width of a sheet metal fold made on a bar folder?

a. length
b. gauge
c. design
d. thickness

S155. Which stops on the bar folder regulate the sharpness of the fold?

a. gauge
b. collar
c. handle
d. wing

S156. Bar folders are used to bend or fold:

a. wire
b. sheet metal
c. band iron
d. rods

S157. Which of the following should be bent on the brake?

a. rod
b. wire
c. flat sheets
d. bands

S158 A highly polished roll is used to form:

a. block iron
b. steel
c. galvanized iron
d. aluminum

S159. Machines with three-inch diameter (or larger) rolls allow the operator to roll:

a. lighter metal
b. heavier metal
c. 24 gauge metal
d. 16 gauge metal

S160. What type of impression is made by the beading machine?

a. square
b. oblique
c. straight
d. curved

S161. Rolls are removed from the beading machine by loosening the circular nut with a (an):

a. allen wrench
b. pipe wrench
c. special wrench
d. hammer and screw driver

S162. What is the most frequently used bead?

a. ogee bead
b. single bead
c. triple bead
d. double bead

S163. What are the results of the crimping process?

a. shrinkage in size
b. enlargement in size
c. corrugation of edges
d. beading of edges

S164. The operator generally inserts the material in the squaring shear from the:

a. back
b. front
c. side
d. bottom

S165. What is the gauge capacity of a standard size, foot-operated squaring shear?

a. 14
b. 16
c. 18
d. 20

S166. How far beyond the lower cutting blade should the edge of a sheet that is to be trimmed be extended?

a. 1/8 inch
b. 1/2 inch
c. 1/16 inch
d. 1/4 inch

S167. What is the gauge capacity of the ring and circle shear?

a. 16
b. 18
c. 20
d. 26

S168. Where on the crimping rolls should the beading rolls be installed in order to bead and crimp at the same time?

a. on the bottom
b. on the end
c. at the top
d. at the side

S169. Which of the following is a metal cutting machine?

a. throatless combination rotary machine
b. box and pan brake
c. ring and circle shear
d. Pittsburg lock hammer

S170. The first dimension that is stated on a working drawing is the:

a. top
b. bottom
c. side
d. edge

S171. A 135° elbow is referred to as a (an):

a. gooseneck
b. change elbow
c. over ninety elbow
d. large elbow

S172. Where on the sheet is the layout of each pattern begun?

a. upper right edge
b. top center edge
c. bottom left edge
d. dead center

S173. What type of fittings generally require the radial line development method?

a. transitional
b. round
c. oblong
d. square

S174. What part of a circle is a 90° elbow?

a. 1/2
b. 3/4
c. 1/4
d. 9/32

S175. All dimensions on working drawings are stated as:

a. raw
b. finished
c. used
d. layout

S176. F.O.B. means:

a. flat on back
b. flat on bottom
c. from other base
d. from other back

S177. The three methods of pattern development are parallel line, radial line, and:

a. bisecting line
b. curved line
c. straight line
d. triangulation

S178. What is the smallest circle the ring and circle shear will cut?

a. 4 inches
b. 3 1/4 inches
c. 2 1/2 inches
d. 1 1/8 inches

S179 **Task** Form a double hem

Tools and Materials

1. Sheet metal
2. Bar folder

Conditions Student should be furnished with a strip of sheet metal. Instructions should be given to make a double hem on the bar folder.

Specifications All measurements should be accurate to 1/32 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Made single hem		
2. Inserted hem with fold edge between bar and jaw		
3. Pushed handle as far forward as possible and then released metal		
4. Turned metal over and inserted the double hem between the folding bar and the blade		
5. Pushed handle forward as far as possible		

- -

Was correct procedure followed to form double hem?

______Yes ______No

Were all measurements accurate to 1/32 inch? ______Yes ______No

S180 **Task** Form a grooved seam

Tools and Materials

1. Sheet Metal
2. Bar folder
3. Hammer
4. Mallet

Conditions Student should be given two pieces of sheet metal and a hand groover. Instructions should be given to make a grooved seam by hand.

Specifications Seam must be accurate and smooth.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Set gauge of bar folder for desired lock		
2. Turned each piece of sheet metal on bar folder		
3. Hooked the two pieces together		
4. Placed metal to be grooved on a flat stake and flattened seam slightly with mallet		
5. Selected hand groover with slot about 1/16 inch wider than width of lock		
6. Placed groover over seam at one end and tapped lightly with hammer, making a short groove		
7. Repeated process and grooved other end		

S180 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
8. Grooved balance of seam by moving along seam		
9. Flattened seam with a mallet		

- -

Was correct procedure used to make the grooved seam?

_______Yes _______No

Was the seam accurate and smooth? _______Yes _______No

S181 **Task** Drill receiver holes in sheet metal with a hand drill

Tools and materials

1. Hand drill
2. Assorted drills
3. Wooden block
4. Vise
5. C-clamp
6. Center punch
7. Hammer

Conditions Student should be furnished with a piece of heavy sheet metal and a hand drill. Instructions should be given to produce a receiver hole.

Specifications The hole must be smooth and accurate.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Securely clamped work		
2. Backed up work with a piece of wood		
3. Center punched hole location		
4. Selected correct size drill		
5. Inserted drill in chuck and rotated to be sure drill turned true		
6. Placed point of drill in center punch mark and drilled hole		

S181 (continued)

Was correct procedure followed in drilling hole?

_______Yes _______No

Was hole smooth and accurate? _______Yes _______No

S182 **Task** Drill receiver holes in sheet metal with an electric drill press

Tools and Materials

1. Electric drill press
2. C-clamp
3. Vise
4. Assorted drills
5. Lubricant
6. Center punch
7. Hammer
8. Heavy sheet metal

Conditions Student should be given a piece of heavy sheet metal and an electric drill press. Instructions should be given to produce a receiver hole.

Specifications The hole must be smooth and accurate.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Located and center punched hole to be drilled		
2. Selected correct size drill		
3. Inserted drill in chuck		
4. Mounted workpiece on holding device		
5. Adjusted table so that point of drill was slightly above workpiece		
6. Set the adjustable stop to secure the proper depth of the hole to be drilled		
7. Applied lubricant		
8. Drilled hole		

S182 (continued)

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Was correct procedure followed in producing the receiver hole?

______Yes ______No

Was hole smooth and accurate? ______Yes ______No

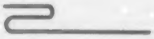
S183 Task Produce a Pittsburgh lock seam

Tools and materials

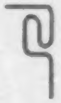
1. Sheet metal parts
2. Brake
3. Wooden mallet

Conditions Student should be given sheet metal parts and a brake. Instructions should be given to form a Pittsburgh lock seam.

Spepcifications The seam must be tight and smooth.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Made 90° bend on 1 1/4 inch line		
2. Removed metal and inserted 1/4 inch into the brake with the large part of the metal pressed against the leaf of the brake		
3. Made bend		
4. Positioned metal as in #2 above		
5. Made bend in metal		
6. Removed metal and positioned as in #2 above		
7 Made bend on the 1 1/4 inch line which was bent to 90° in step #1 above		
8. Beat metal to the posiiton shown below: 		

S183 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
9. Inserted metal in brake and flattened with the upper leaf		
10. Removed, turned over, and clamped metal		
11. Bent metal to approxiamtely a 15° angle and beat to the position shown below: 		
12. Bent the single edge		
13. Set the ends into the Pittsburgh lock seam		

[illegible] correct procedure followed in making the Pittsburgh lock seam?

______Yes ______No

Was the seam tight and smooth? ______Yes ______No

S184 **Task** Solder sheet metal

Tools and Materials

1. Sheet metal strips with groove seam
2. Soldering copper
3. Solder
4. Flux
5. File
6. Ball peen hammer
7. Block of sal ammoniac

Conditions Student should be given two pieces of galvanized sheet metal with a groove seam and soldering equipment and supplies. Instructions should be given to solder the seam.

Specifications The seam must contain no burns and show a good appearance.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Placed seam to be soldered in the proper position		
2. Forged the tip of the soldering copper		
3. Tinned sides of the soldering copper		
4. Applied flux		
5. Applied beads of solder to opening of the seam		
6. Placed copper on metal with the side of the point on the seam		
7. Soldered seam		

S184 (continued)

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Was correct procedure followed to solder seam?

______Yes ______No

Was seam without burns? ______Yes ______No

S185 **Task** Cut sheet metal with hand tools to produce a circular cut

Tools and Materials

1. Sheet metal
2. Sheet metal pattern
3. Aviation snips
4. Combination snips
5. Cold chisel
6. Mallet
7. Squaring sheers

Conditions Student should be furnished with sheet metal and sheet metal pattern with a small circle inside a larger circle. Instructions should be given to cut out the circle.

Specifications The circular cut should be accurate to the nearest 1/32 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Used correct pattern layout techniques for circle shown on pattern		
2. Used squaring sheers to trim excess metal leaving 1/2 inch of metal from the line		
3. Used combination or aviation snips to cut outside of large circle		
4. Punched large hole inside inner circle, or made a slit with a mallet and chisel		

S185 (continued)

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
5. Cut excess metal from inside the circle staying about 1/2 inch from the line		
6. Trimmed metal to inside circle		

- -

Was correct procedure used to cut circle?

______Yes ______No

Were edges smooth and cut made with accuracy to nearest 1/32 inch?

______Yes ______No

S186 **Task** Cut sheet metal with hand tools to produce a straight cut

Tools and Materials

1. Sheet metal scrap
2. Layout blue
3. Training square
4. Combination snips
5. Scratch awl

Conditions Student should be given a sheet metal scrap, layout and cutting tools. Instructions should be given to cut a straight line.

Specifications The line must be straight and accurate to within 1/32 inch.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Covered one side of sheet metal without layout blue		
2. Scribed a line on the sheet metal		
3. Scribed a line on either side of the first line and 1/32 inch away		
4. Cut on center line with combination snips		

Was the correct procedure followed in making the cut?

______Yes ______No

Did the cut display smooth edges and an accuracy within 1/32 inch?

______Yes ______No

S187 **Task** Crimp sheet metal

Tools and Materials

1. Pieces of pipe
2. Combination crimping and beading machine
3. Crimping rolls

Conditions

The student should be given two pieces of light gauge pipe, crimping rolls, and a crimping machine. Instructions should be given to crimp the end of one piece of pipe so that it fits into the other piece of pipe.

Specifications

One piece must fit snugly into the other piece.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Selected rolls for crimping		
2. Attached rolls to machine		
3. Inserted workpiece between rolls		
4. Turned handle and crimped workpiece		

Was correct procedure followed in crimping pipe?

______Yes ______No

Did the crimped pipe fit snugly into the other pipe?

______Yes ______No

S188 Task Bead sheet metal

Tools and Materials

1. Cylindrical piece of sheet metal
2. Beading machine
3. Beading rolls

Conditions The student should be given a cylindrical piece of sheet metal, beading rolls and a beading machine. Instructions should be given to form a single, ogee, or triple bead.

Specifications The bead must be consistently formed and smooth.

Procedure	Acceptable Behavior Observed	Acceptable Behavior Not Observed
1. Selected beading rolls for type of bead desired		
2. Attached beading rolls to machine		
3. Read scale at inner edge of bead and set gauge		
4. Tightened screw on bottom of gauge		
5. Inserted workpiece between rolls against gauge		
6. Tightened crankscrew on top of machine		
7. Turned handle and beaded workpiece		

S188 (continued)

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Was correct procedure followed in beading workpiece?

_______Yes _______No

Was bead smooth and consistently formed?

_______Yes _______No